The Chemical Age

A Weekly Journal Devoted to Industrial & Engineering Chemistry

VOL. V. OCTOBER 29, 1921 No. 124

Contents

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

The prepaid subscription to "The Chemical Age" is 21/- per annum for the United Kingdom, and 26/- abroad. Cheques, P.O.O.'s, and Postal Orders should be made payable to Benn Brothers, Ltd.

Editorial & General Offices—8 Bouverie Street, London, E.C.4.
Telegrams: "Allangas, Fleet, London." Telephone: City 9852 (4 lines)

Our Mining Annual

THE present issue of THE CHEMICAL AGE is specially concerned with mining and metallurgy, industries in which the co-operation of the research chemist is becoming increasingly important. Any doubts on this point, if any existed, would be easily dispersed by a study of Sir Robert Hadfield's address to the Association of Metallurgists and Metallurgical Chemists at Sheffield on Monday. There it is shown how largely the application of research to industry explains the pre-eminence of Sheffield in the manufacture of high grade steels and other metals and alloys. Sir Robert has long been one of the most persistent advocates of adequate research departments in all large works, and the position his own firm has come to occupy in the steel industry supplies the best evidence as to the good commercial results of this policy. Some indication of the close connexion between chemistry and the mining and metallurgical industries may be found in the special contributions to this issue. These include articles on "Modern Developments in Non-Ferrous Metallurgy" (W. R. Barclay, O.B.E.), "Mining and Metallurgy in South Africa" (W. Cullen, M.I.M.M.), "The Industrial Future of Electro-deposited Iron" (W. E. Hughes, B.A.), "American Sulphur Mining," "Leaching Iron Ores for Phosphorus" (R. M. Winslow), and "The Separation of Sphalerite, Silica, and Calcite from Fluorspar" (John Gross).

The Case of Cream of Tartar

As an example of the attitude of importers to the list of articles drawn up under Part I. of the Safeguarding of Industries Act, we are given to understand that a strong protest is being prepared by a number of the leading importers and distributors of cream of tartar against its inclusion in the list. The case to be put before the authorities by the signatories is shortly the following:—

Cream of tartar is not a key industry. From a practical point of view it could hardly be considered as a fine chemical, as it is used practically only as an aerating agent in the bakery and confectionery trades. The demand for cream of tartar is sure to fall off should the price be raised now that the duty has come into force. Further, steps have been taken on the Continent to place an export duty of 33⅓ per cent. on tartaric acid raw materials for export to the United Kingdom, which will, of course, have the effect of increasing the price of the British-made product. The statistics for the last few years show that an increase in the present price would seriously decrease its use in the British trade, to the detriment of British and foreign industry and commerce. The following figures are cited:—

	Imports. cwt.	Exports. cwt.	Consumed. cwt.	Average price.
1913	79·700	10·020	69·680	85/0 per cwt.
1919	23·887	9·578	14·309	320/0 per cwt.
1920	53·463	22·057	31·406	240/0 per cwt.

It is further claimed that as Part II. of the Act specifically states that articles used as food and drink are not affected, this clause excludes *ipso facto* cream of tartar, which is an article of food. In conclusion, it is claimed that a duty on cream of tartar is contrary to public health as this would increase the use of substitutes in the form of acid phosphates.

There can be no doubt that importers are being very seriously hit by the new restrictions; at the same time, even among merchants, there is a certain degree of divided opinion, as, for example, on the question of phosphates. It is but fair, also, to British manufacturers to state that generally they have not taken advantage of the Act to put up their prices. As to the statistics quoted, it appears to be assumed that the exports consist entirely of imported material, though some competent judges estimate the British article to represent fully 60 per cent. of the exports. If, as a measure of retaliation, Continental producers get a duty imposed on the exportation of the raw product this would seriously affect the price of the

British article, but this, of course, is problematical. After all, while importers are entitled to the fullest sympathy in their difficulties, some account must also be taken of the difficulties, no less serious, of manufacturers. Those who produce cream of tartar and phosphates, for example, employ quite considerable numbers of men, and the country cannot afford to see important works shut down. The problem is how to balance equitably in the national interest the conflicting interests of maker and importer.

Precautions with Pulverised Coal

THE advantages attending the use of pulverised coal are so obvious, and the successful development of the process from the standpoint of fuel economy is of such importance that it behoves all who are interested in the matter to profit by the experience of those who have had first-hand acquaintance with systems of the kind. In discussing the matter with chemical engineers we have been pleasantly surprised to find that they by no means regard the utilisation of pulverised coal in that apathetic attitude which is so frequently displayed in this country with comparative novelties. Indeed, one might anticipate a very rapid development of the process were it not for the fact that considerable prominence has been given to one or two disasters which have occurred in America, and this naturally inculcates a certain feeling of insecurity. There can be no denying that the dangers of any process must be fully appreciated if accidents are to be avoided; but it may certainly be said that there is no more need for alarm so far as the pulverisation of coal is concerned than there is with the majority of technical operations now in everyday use. The recent investigations of the United States Bureau of Mines have been very productive of useful hints and precautions which those who are interested in the system will do well to note. For instance, one of the most serious troubles which has had to be contended with is fire in the storage bins. It has been difficult to determine the exact cause of these fires, but undoubtedly spontaneous combustion has played an important part in their origin. Care must be taken that the coal when pulverised is not shot into the bins at a high temperature; and, to avoid this, the gaseous products from the drying furnace must not be permitted to become hot enough to overheat the coal. Many of the precautions which have to be observed in the storage of ordinary bituminous coal apply with much greater force to the storage of the pulverised material, *i.e.*, the bins must not be placed in any position where they may become heated from adjacent furnaces, steam pipes, or hot flues. Again, a small stream of pulverised coal leaking down from a defective joint in a transport line does not probably attract much attention. As a matter of fact, if the cloud produced should by any means come in contact with an open flame or similar igniting agent the effect would be disastrous. The accumulation of experience, however, is bringing into the open all those features of the system which at the outset were not recognised as sources of danger; and, provided the plant is operated in full knowledge of the results which might follow indifference to ordinary precautions, there is no reason why pulverised coal should not quickly establish itself in this country.

Finer Aspects of Fuel Saving

THERE is a distinct possibility that the efficiency of many processes in which thermal considerations are involved will undergo marked improvement during the next few years. Perhaps, one of the most prominent instances where a substantial saving has been effected is in connexion with waste heat recovery, as an example of which one may allude to the satisfactory solution of the problem of making water gas producers self-steaming. Much of the present-day apparatus for the production of gas of all varieties involves an extraordinarily heavy loss in the sensible heat which escapes into the atmosphere, and the fact that this waste was allowed to continue unchecked for so many years may mainly be ascribed to the cheapness of coal at the end of the last century and the early years of the present one. Fuel to-day, however, whether solid, liquid, or gaseous, has risen to prices which demand its utilisation in the most economic form; and, though industry is severely handicapped by this increase in value, the situation has the merit of having stimulated research which might otherwise have never been considered worth while.

Apart from generating processes a good deal of attention has been given to fuel-consuming appliances. For instance, we have the remarkable principles involved in the Still engine, and again the endeavour to adapt the famous Haüsser process to nitrogen recovery from the exhaust gases of the gas engine. The petrol engine affords another good example, for the utilisation of the available energy in the waste gases shows considerable promise in the case of large installations. Several outlets for this energy are available, *e.g.*, the driving of compound exhaust turbines, raising steam for auxiliary turbines, also cooking and heating. One authority on the subject has pointed out that it is, of course, impossible to utilise in practice more than a certain proportion of the waste energy, but there is no reason why from 10 to 15 per cent. should not be actually available for power supply purposes. The main reason why only a proportion of the energy is recoverable is that, if too great utilisation is attempted, the back-pressure in the exhaust rises and higher temperatures occur. Moreover, it has been shown that thermal efficiency falls away fairly rapidly above a certain back-pressure limit. The problem, however, is by no means incapable of solution, and although the exhaust gas turbine is still in a comparatively early stage of development it presents great possibilities in the direction of the refinements of fuel saving.

British or German Glassware

MR. J. E. PETAVEL, director of the National Physical Laboratory, recently contributed to *Nature* an instructive comparison of British and German volumetric glassware. The manufacture of volumetric glassware, he pointed out, was practically non-existent in this country prior to the war. During and since the war it has been developed on an extensive scale. Unfortunately, many users of volumetric apparatus believe that the accuracy of British apparatus is inferior to that of German origin. Experience at the National Physical Laboratory shows that apparatus of British manufacture which has passed their tests is at least as good as any

similar standard apparatus of German origin. It appeared to be a matter of some interest, however, to ascertain the degree of accuracy of ordinary grade volumetric apparatus. Consequently in November last samples of glassware were obtained from seven different London firms. Ordinary commercial-grade apparatus was asked for and the purchases were made by a third party, the firms being quite unaware that the apparatus was ultimately destined to be tested at the National Physical Laboratory. In March last purchases were made in a similar manner, but it was stipulated that the apparatus must be of German manufacture. Of about half-a-dozen firms visited, only two would undertake to supply apparatus of German origin.

The results relating to apparatus bearing well-known British trade marks are described as very satisfactory. The results for the German apparatus clearly show that such apparatus cannot be accepted on trust, as many users appear to imagine. For example, the 50 c.c. German pipettes include a number which have excessive errors and delivery times so short as to render them likely to give inconsistent results. The ordinary grade German apparatus has no claim to superior accuracy as compared with ordinary grade British apparatus. The results indicate that, where accuracy is of importance, apparatus should be tested before use, and that in cases where untested apparatus is to be used the safest procedure is to obtain apparatus bearing the trade mark of British firms which make a feature of supplying apparatus marked by the National Physical Laboratory. Their experience in the manufacture of such apparatus is clearly reflected in the increased accuracy of their ordinary output as compared with apparatus not bearing their trade marks.

An Institution of Chemical Engineers

WE understand that a meeting is to be held on Wednesday, November 9, at the Engineers' Club, London, to discuss the best method of forming an Institution of Chemical Engineers. Sir Arthur Duckham, K.C.B., will preside, and will be supported by other representatives of various branches of industrial activity allied with the profession of chemical engineering. It is felt by those who are moving in the matter that the formation of such a professional body is an urgent necessity if the manufacturing reputation of the country is to be maintained, and its industrial efficiency increased. A corresponding American organisation has been in existence for over fifteen years, and it has expressed a willingness to co-operate with the British Institution, if and when formed, and is quite willing to give the British Institution the benefit of its own experiences in attaining maximum efficiency. It has been suggested that in the first instance a provisional institution should be formed, that membership of this provisional institution should be open at once to all chemical engineers or those interested in chemical engineering, and that this provisional institution should proceed to form the final institution by charter or otherwise. The meeting on November 9 will be preceded by an informal dinner, and those interested are requested to communicate with Professor J. W. Hinchley, at the Imperial College of Science and Technology, South Kensington.

The Study of Rubber

THE Institution of Rubber Industry began last week what promises to be a very useful series of meetings for the coming winter session. In addition to the address of the president (Mr. J. H. C. Brooking) there were contributions by Sir Henry Wickham respecting his experiences in selecting rubber seeds from Brazil in 1876, and Mr. Herbert Rogers on rubber manufacture. A comprehensive syllabus of subjects has been drawn up, and arrangements for papers already made with Dr. H. P. Stevens, Dr. S. S. Pickles, Mr. Fordyce Jones, Dr. Schridrowitz, Captain F. J. S. Gray, Mr. S. J. Peachey, Dr. J. Torrey, Dr. W. C. Geer and Mr. J. L. Rosenbaum. Meetings are to be held monthly in London, and at three provincial centres (Manchester, Birmingham and Glasgow). The course promises to be educational in the widest sense of the word, covering the chemistry, technology, and commercial aspects of rubber production and treatment. Any readers interested in the matter may obtain particulars from the Secretary of the Institute, Charing Cross House, W.C.2.

The Calendar

Nov.		
1	Royal Photographic Society: Presidential Address by Mr. G. H. Rodman. 7 p.m.	35, Russell Square, London.
1	Hull Chemical & Engineering Society: "Some Applications of Physical Chemistry to Industry." J. Price Jones. 7.30 p.m.	Hull.
2	Society of Public Analysts and Other Analytical Chemists: Papers by C. Butler Savory; J. C. Drummond and A. F. Watson; A. Lucas. 8 p.m.	Burlington House, Piccadilly, London.
2	The Industrial League and Council: "Ability as a Factor in the Production of Wealth." Mr. E. C. de Segundo. 7.30 p.m.	Caxton Hall, Caxton Street, Westminster, London.
3	Chemical Society: Informal Meeting. 8 p.m.	Burlington House, Piccadilly, London.
3	Society of Chemical Industry (Bristol & South Wales Section): "Lubrication." L. Archbutt.	Bristol.
4	Society of Chemical Industry (Manchester Section): "Electrical Precipitation." Dr. H. J. Bush. 7 p.m.	Textile Institute, 16, St. Mary's Parsonage, Manchester.
7	Society of Chemical Industry (London Section): 8 p.m.	Rooms of the Chemical Society, Burlington House, Piccadilly, London.
18	Chemical Industry Club: Third Annual Dinner.	Connaught Rooms, London.

Books Received

A CATALOGUE OF BRITISH SCIENTIFIC AND TECHNICAL BOOKS. Prepared by a Committee of the British Science Guild. London. Pp. 376. 10s. net.

AN INTRODUCTION TO BIOPHYSICS. By David Burns. London: J. & A. Churchill. Pp. 435. 21s. net.

RADIOACTIVITY AND RADIOACTIVE SUBSTANCES. By J. Chadwick, London: Sir Isaac Pitman & Sons, Ltd. pp. 111. 2s. 6d. net.

Modern Developments in Non-Ferrous Metallurgy

By W. R. Barclay, O.B.E.

In the following article the author reviews, as comprehensively as is possible in a single contribution, modern developments in non-ferrous metallurgy. He insists on the continued prosecution of research and on co-operation between the engineer and metallurgist and concludes with the view that the success of British industry depends on "hard work combined with high ideals of quality of production, intelligent organisation, and bold exploration of new fields."

THE science and—in a lesser degree—the practice of non-ferrous metallurgy so far as manufactured or semi-manufactured metals are concerned has made such considerable advances during the last few years that a throughly well-balanced review of modern developments is not easy to make.

On the scientific side of the subject, the introduction into works laboratory practice of the principles and methods of physical chemistry in the study of alloys has led, not only to a much more adequate knowledge of their fundamental principles, but to a far greater understanding of their possibilities as compared with simple metals.

The apprehension of the essential nature of metallic mixtures as coming within the bounds of the physico-chemical laws governing solutions, with its necessary concomitants—heating and cooling curves and equilibrium diagrams—has opened up a vast area of possibilities of new knowledge. Such new knowledge is now sought not only in university and in other research laboratories of similar standing, but in industrial and works laboratories in close co-operation with works practice. Unquestionably, this development will mean far greater progress in the future than in the past. We are only just beginning to reap even the earliest crops of the seed sown during the past quarter of a century.

It has become almost a platitude to say that non-ferrous metallurgy is twenty years behind ferrous metallurgy in its application of scientific principles, but that is a reproach which is steadily losing its point. Non-ferrous metallurgists in works practice are now very much alive to the necessity of applied science in their art.

Probably the truth just at the moment is that the industry is receiving more from its scientific leaders than it can assimilate, and one is occasionally tempted to wish that the volume of papers could be temporarily stayed, so that there might come a period of quiet and ruminative digestion.

It must also be admitted that there is, unfortunately, a good deal of attempting to put "new wine into old bottles," with the usual disastrous consequences. Nevertheless, progress is being steadily made.

As in many other industries, the war has been the cause, directly or indirectly, of many of the most important recent developments of non-ferrous metallurgy—not so much by bringing out new alloys as by raising standards of quality, and very materially widening the range of uses of non-ferrous metals in general.

The Engineer and the Metallurgist

In this connexion, it is instructive to note the causes of the intensive development of ferrous metallurgy during the last 25 years. These are, in great part, the increasingly exacting demands of the modern engineer. A striking feature of our recent industrial history has been the closer co-operation of the engineer and the ferrous metallurgist—a co-operation which has meant real progress, as, *e.g.*, in the development of alloy steels.

During the war the engineer began to make, in much greater degree than before, a similar type of demand on the non-ferrous metallurgist. He demanded, for example, a much higher standard of soundness of material, exactness and uniformity of composition, and adhesion to specified physical and mechanical properties, than had hitherto been usually conformed to. Some of these demands came on the trades with a very unpleasant shock, but it is unquestionable that their effect has been good, and will be still better in the near future.

Scientific Co-operation

Incidentally, it may be remarked here that Birmingham—the centre of the non-ferrous metal trades—has led the way in a most interesting development of the application of science to industry in the establishment early in 1918 of a co-operative metallurgical laboratory. The origin of this movement is very interesting. It was realised by several important firms that a works laboratory, to be of the fullest possible value to production, must be both thoroughly well equipped and adequately staffed. Compared with the ferrous industries, non-ferrous works are relatively small, and such a laboratory as is possessed by an up-to-date steel works is altogether out of proportion in cost to the capacity of most non-ferrous firms. What was not possible for one firm was, however, easily possible to a combination of firms, and it speaks volumes for the foresight and vision of the business men concerned that ten firms were ultimately brought together—not as a financial trust, but with the simple object of equipping and staffing such a laboratory as would be entirely adequate for their needs and very greatly superior to that (financially) possible to a single firm. A very suitable self-contained building of three floors was found in the business centre of the town and leased for a period of years. It is equipped not only for routine chemical analysis, but for physical and mechanical testing, for metallographic investigations and for pyrometry work, and is steadily increasing in both usefulness and influence in the works of its constituent members. It does not confine its work to the purely metallurgical side of works practice, but concerns itself in the qualities of all the materials used—*e.g.*, oil, fuel, refractories and general materials, as also efficiency of furnaces, &c.

Quite recently industrial investigations of the utmost value to some of its members have been carried out, and handsome tributes have been paid to the quality of its work. Such a movement is tangible evidence of enlightened progress, and suggests possibilities of no little importance to British manufacturers.

Light Alloys

Coming now to more intimate details of modern developments, a prominent place must be given to the great progress made in the production of light alloys. In no section of non-ferrous metallurgy during the last 10 to 15 years has more intensive scientific and industrial research work been done than in aluminium and aluminium-rich alloys. Obviously this is due in a large measure to war demands in aeronautical engineering, but it is also due to the interest taken in aluminium and its alloys by engineeers and metal users generally.

The combined advantages of moderate strength and light weight offered by a number of aluminium alloys are very attractive. In this respect more importance must be attached to the alloys than to aluminium itself, since the pure metal is, in its hot worked condition, relatively very low in the scale of values of mechanical properties. A number of aluminium-rich alloys, however, do combine a relatively high tensile strength with a specific gravity sufficiently low to represent a saving in weight for equal mass of approximately two-thirds. Moreover, many aluminium alloys are quite well suited to the production of sand castings whereas pure aluminium is very unsuitable.

The introduction (originally in Germany and afterwards in this country) of the rather complex proprietary alloy known as "Duralumin," which in addition to aluminium contains copper, magnesium and silicon (often with manganese and iron as impurities), probably marks the earliest stirrings of general industrial interest in the light alloys. And this alloy may be taken as fairly typical of the standard of physical and mechanical properties now expected of such materials, viz., a maximum strength in the wrought and unheat-treated condition of about 18 tons per square inch, and an elongation between 30 and 40 per cent., with a possibility by means of heat treatment and cold-working of reaching a maximum stress value of over 30 tons per square inch. Such values in a metal of only about one-third the weight of the ferrous and most non-ferrous alloys hold out considerable engineering promise.

While Duralumin is probably the most widely known wrought aluminium alloy, a number of others are now being made as a result of modern researches carried out in the

National Physical Laboratory and elsewhere, which closely correspond in physical and mechanical qualities.

Several of these at least deserve brief mention, even in a cursory review of the subject, particularly.

(*a*) The N.P.L. high tensile alloy, which consists of

Copper	2·5 per cent.
Zinc	20·0 ,,
Manganese	0·5 ,,
Magnesium	0·5 ,,
Aluminium	Remainder

This material gives a rather higher tensile strength than any other wrought alloy of the light alloy class, giving after heat treatment a maximum stress value of nearly 40 tons per square inch.

(*b*) Another closely similar alloy is that known as the 3/20 alloy containing

Copper	3·0 per cent.
Zinc	20·0 ,,
Aluminium	Remainder

This material is not so strong as Duralumin or the N.P.L. alloy above mentioned, but it has the advantage that it does not require heat treatment.

(*c*) A third alloy is one very closely analogous to Duralumin, but containing nickel. Its composition is approximately

Copper	4·0 per cent.
Nickel	2·0 ,,
Magnesium	1·5 ,,
Aluminium	Remainder

This alloy promises well as offering a high resistance to corrosion. It was introduced by the Light Alloys Committee of the Air Boards Advisory Committee for Aeronautics. Like Duralumin it only exhibits its best mechanical properties after heat treatment. Both the strength and fatigue range of this alloy are similar to Duralumin. It is generally know as the "Y" alloy.

The foregoing alloys are all used as wrought alloys. For sand castings the alloys at present developed are for all practical purposes confined to the aluminium-copper and the aluminium-zinc series, though an alloy similar to the "Y" alloy referred to above has given considerable promise of usefulness in castings.

In view of the many manufacturing difficulties encountered in the industrial production of these alloys, considerable credit must be given to the non-ferrous industries both in this country and abroad for the relatively high standards reached in so short a period.

It is necessary, however, to point out that though this work deserves a prominent place in a review of modern developments, the time is hardly yet ripe for a considered judgment as to its place in industry.

In the use of metals, particularly in engineering, nothing but long practical experience will determine the exact place of any class or type.

Nickel and Its Alloys

The manufacture of nickel and nickel alloys has also made considerable advances during the last 10 to 20 years, and in the writer's view this class of non-ferrous materials will take a very prominent place in the not distant future.

Here, again, it is the war and its demands which is responsible for the greater part of what progress has been made.

The alloy known as 80/20 cupro-nickel used for bullet envelopes may be quoted as a fair example of the way in which munition requirements have raised standards of production and stimulated demand in new directions. Prior to 1914 the manufacture of this alloy was confined to a very small circle of firms outside Woolwich Arsenal itself. Even in these it was only made on a relatively small scale, and knowledge of either its manufacturing difficulties or its properties was limited to a few workers.

The war, with its huge demands for small arms and machine-gun ammunition, burst all barriers of secretiveness (if any existed) and extended the circle of manufacturers from units to (literally) hundreds, and apart from the increased knowledge of cupro-nickel itself, which was thus gained so intensively, there can be no doubt that the high quality of material demanded insensibly raised the general standards of production in all the works affected. Still further, the manufacture and use of this alloy on so large a scale revealed to engineers and others who had little previous knowledge of it the really wonderful properties this and similar alloys possess.

The nickel-copper alloys throughout their whole range possess most valuable physical properties.

The alloys rich in copper, notably the 85/15, 80/20 and 75/25 alloys, all possess appreciable tensile strength (in the "as cast" condition round about 20 tons per square inch), and along with their strength exceptional ductility.

They are, therefore, very suitable for deep stampings, spinnings, or pressings, and being reasonably hard, very tough, and possessing considerable resistance to corrosion are suited to a great variety of industrial uses.

Since the war many new demands for these alloys have developed, *e.g.*, in automobile engineering, and others will undoubtedly follow.

Engineers particularly are following with considerable interest the introduction of the 85/15 and 80/20 alloys into condenser-tube work (U.S. Navy and elsewhere).

Nickel-Rich Alloys

The nickel-rich alloys are even more valuable. They are decidedly superior to the whole range of copper alloys in such properties as tensile strength, toughness, strength at high temperatures, and resistance to corrosion.

Nickel alloys containing more than 50 per cent. of nickel are exceptionally resistant to nearly all the usual corroding media. The loss of weight of several such alloys after some hours' immersion in boiling 20 per cent. sulphuric or hydrochloric acid is almost negligible.

It is this wide range of useful engineering and industrial properties which accounts for the popularity in many directions of the modern alloy known as "Monel" metal—which is, for all practical purposes, simply a nickel-rich copper-nickel alloy with a small percentage of iron and manganese. The properties of this alloy are entirely due to its high nickel content, and for use under stress at temperatures of the order of 300° or 400°C. it has been shown to be distinctly superior to any of the generally known copper alloys at present on the market (*see, e.g.*, Report of Technical Department of the Air Ministry, 1920, p. 93).

In view of the modern requirements of engineering this property of strength at elevated temperatures is of increasingly vital importance.

Several other binary alloys of nickel—a specific example which may be quoted is nickel-manganese—have also come to the front recently. The addition of manganese to nickel up to about 10 per cent. imparts an all-round improvement to the mechanical properties of the metal, and alloys of this type are now being used for sparking-plugs and valve work, as also in dentistry.

In the "German or nickel-silver" class of nickel alloys (nickel-copper-zinc) a notable modern feature is the introduction of "hot-working" alloys capable of being used in drop stampings and forgings. They differ from the normal alloys of this class—which are invariably cold-worked—in having a considerably greater proportion of zinc and less copper in their composition.

No reference to nickel and its alloys can be complete without mention of the important development of the nickel-chromium alloys, which have most valuable acid and heat-resisting properties, in addition to being important electrical resistance materials. These alloys have developed mainly in America, in which country a number of patents have been taken out, but they have also been manufactured here and on the Continent.

In 1896 Placet, a French chemist, in a patent specification, emphasised the valuable properties of the non-ferrous alloys of chromium, particularly pointing to their power of resisting heat and acids. It is also clear that he realised their value for electrical work. The commercial development of these alloys, however, appears to have dated from about 1906, when the alloys of nickel and chromium began to be manufactured in the United States. Most of the commercial products now on the market are ternary alloys of nickel, iron and chromium, though the higher grades contain little more than 2 or 3 per cent. of iron. Alloys of the latter type possess appreciable strength even at temperatures approximating 1,100°C. and do not scale.

Pure Nickel

The production of pure nickel itself in malleable form is also relatively a modern development. Originally introduced in 1879 in Germany by Fleitmann, its manufacture in this country and the United States has made considerable progress during the last few years, and a very high grade of quality has been reached. Its uses are also extending, but its range of industrial employment is by no means clearly defined as yet.

In the more widely known copper and brass sections of the non-ferrous industries, the last decade has undoubtedly marked a distinct advance in standards of quality, although no outstandingly new alloys have been introduced. Some alloys which 10 or more years ago promised great things have not developed to anything like the extent hoped for. An example is the aluminium-bronzes. The classical investigations of Carpenter and Edwards on these alloys (copper-rich alloys of copper and aluminium) revealed their possession of a high tensile strength together with considerable malleability, ductility and toughness, and many metallurgists hoped for a prominent place for them in general engineering practice. They have, however, suffered materially from the competition of the high tensile brasses, which are distinctly cheaper and easier to manufacture. It is probably in the production of these high tensile alloys that greatest progress in the brass industries has recently been made. Their basis is, of course, the 60/40 brasses (60 copper 40 zinc), to which additions of such metals as iron, nickel, manganese, tin and aluminium are made jointly or severally. The addition of these, and some other elementary metals, to 60/40 brass has the effect of considerably raising the tensile strength of the alloy without material sacrifice of other properties. Nickel, manganese and aluminium together, are specially valuable; not only giving increased strength at normal, but often imparting a 50 per cent. increase of strength at high temperatures (300° to 350°C.).

Die Casting

Brief mention should be made of the steadily increasing popularity of die casting. Good die castings present notable advantages over sand castings, and have important engineering uses. Considerable interest attaches to the development of suitable alloys for this class of work. Up to the present the field is mainly occupied by rich-zinc alloys, but attempts are now being made to develop alloys of greater tensile strength.

Methods of Production

In the production of the non-ferrous metals and alloys in commercial form no revolutionary developments can be reported. Much has been written and still more said on the relative merits of coke, gas, oil or electrically heated, casting and annealing furnaces, but so far as the casting of non-ferrous metals is concerned, the older coke-fired pit type of crucible furnace still holds its own with certain modifications of design, which give greater efficiency of combustion and reduce clinking troubles. During the war tilting furnaces fired by oil, gas or coke, became popular for certain products (mainly brass and rich copper alloys), but most of these have been given up since the Armistice—not necessarily because they were inefficient, but because of the greatly reduced output demands.

Electric melting of non-ferrous metals is a subject which is demanding and obtaining considerable attention. In the United States it has made very great strides. A recent writer* states that the total number of electric furnaces in operation in the U.S.A. in January, 1921, melting non-ferrous metals, was 318. It is doubtful if the number in this country has yet reached double figures. Several furnaces of the arc type are in operation for nickel and some nickel alloys, and recently an American furnace for melting brass and copper alloys has been installed in Birmingham, but much hesitation is being shown to their general adoption.

In annealing furnaces oil-firing is slowly proving to have distinct advantages—particularly in high temperature work. Producer gas furnaces are also now largely used, but coal and coke fired furnaces are by no means ousted yet. Electric-annealing has hardly become a serious proposition.

In semi-manufactured materials the extrusion process assumed great importance during the war, and while, of course, demands are now greatly reduced, extruded rods and bars in both light and heavy metals have thoroughly established their place as commerical products.

* Gillett. Trans. Amer. Electro-Chem. Socy., 1921. Abstr. Soc. Chem. Industry. Vol. XL., No. 19, p. 701A. Advance copy.

Research and the Non-ferrous Industry

Much earnest attention is now being given to the subject of industrial scientific research, and great significance must be attached to a recent movement towards bringing the important brass and copper trade associations into closer touch with the newly formed British Non-ferrous Research Association (one of the associations established under the Government Million Fund Scheme).

Should this movement succeed, the members of these trade bodies will practically control the policy of the Research Association, and enormous possibilities lie ahead if wise and enthusiastic guidance is thus given to organised researches of definite industrial importance.

All British industries are passing through most difficult and trying times, the ultimate issue of which cannot yet be foreseen. One thing, however, at least is clear, their future success depends almost entirely on the human element, *i.e.*, on hard work combined with high ideals of quality of production, intelligent organisation, and bold exploration of new fields. In no branch of industry is this truer than in the manufacture of non-ferrous metals and alloys.

Producer, Distributor and User

To the Editor of THE CHEMICAL AGE.

SIR.—A former Japanese student in one of our largest chemical works (in the year 1900) has written to me to devise and tabulate in several national standards a method of storing various chemicals, in such a manner that stocktaking, and in many cases sales and distribution, may be carried out by measurement only, in and from the original receptacle. He says:

"We are anxious to extend our sales all over the world. Competition is keen, and we are seeking methods to meet it. Amongst other matters, we think that it is time the producer understood the needs of the distributor and user, and also met those needs in a manner suited to 1921."

He then refers to matters that I had in hand (similar to what is now required) in Kobe and Nagasaki in 1894-7 and 1905.

The sense of the matter is that labour charges in distribution and use are considerable, and that the producer can carry out such both more cheaply and better than anyone else. In addition, loss of material would be greatly lessened if he studied the matter of putting his goods in suitable packages and supplied the requisite data.

In a recent case (for London) a receptacle for measuring a powder (used in nine separate quantities) in heaps laid on a long bench for use by the workmen was made by a plain metallic expanding band, whose several dimensions were based upon the data supplied by the producer of the powder. Two men are now required where six were formerly employed.

I am not replying to this Japanese letter, but thought it might interest your readers.—Yours, etc.,

October 9. ADVANCEMENT.

Income Tax Reliefs, 1921-22

To the Editor of THE CHEMICAL AGE

SIR.—The majority of taxpayers receiving the notices of assessment at present being issued, are by now more or less cognisant of the usual deductions claimable for earned income (tenth), personal allowance (single £135, married £225, wife to £45 if earning income), children allowance (first £36, and each additional £27), housekeeper (£45), widowed mother (£45), dependent relative (£25), first £225 of taxable income at 3s., and life insurance premiums from 3s. to 6s. per £.

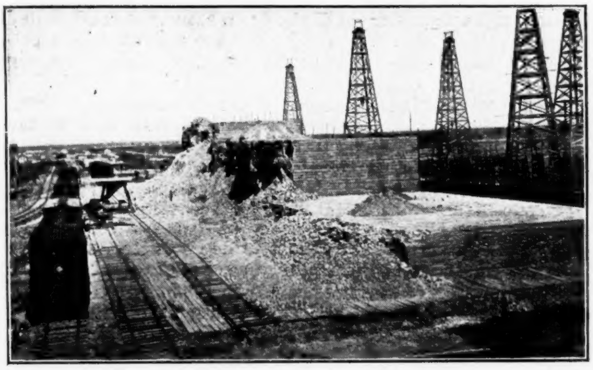
There are, however, other reliefs which are less familiar, but equally important, and any claim should be made at once in respect of these, viz., assessment on average for subordinate company employees, expenses wholly and necessarily incurred, wear and tear of plant and machinery, gross schedule "A" for mills, factories, &c., Dominion income tax suffered, untaxed interest of preceding year to be discharged (under recent decision) if source thereof has ceased, and allowance of over ⅛ of rent or annual value of business premises used partly for residence.—Yours, etc.,

67-68, Cheapside, E.C.2. W. R. FAIRBROTHER.

American Sulphur Mining

The following article is based on information furnished by Messrs. Chance & Hunt, Ltd., 61/62, Gracechurch Street, E.C.3, to whom inquiries concerning the Texas Gulf Sulphur Company's product may be made.

THE sulphur industry has developed with increasing speed with the advance of civilisation. Sulphur is found widely distributed in the world, but deposits of commercial importance are not numerous. For centuries Italy, with Sicily, was the principal producer. The methods of mining used then were very crude and consisted in digging the sulphur ore, in which the sulphur formed anywhere from 15 to 50 per cent. of the total weight, out of the ground by hand, and piling it in great heaps either on top of the ground or in special pits dug in the

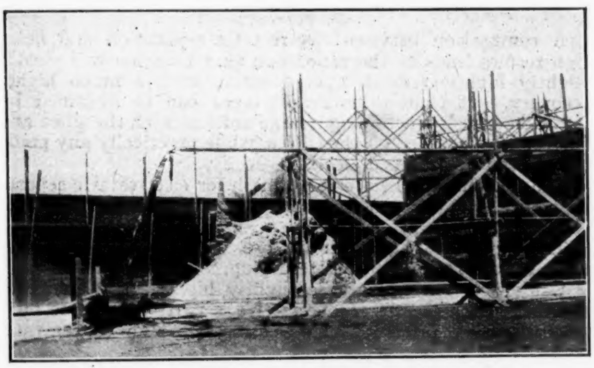


WELLS AND LOADING TRACKS.
(*Texas Gulf Sulphur Co.*)

ground. These heaps, called calcaroni, were then lighted and a large proportion of the sulphur was burned directly out of the ore in order to furnish heat to melt the one-third or the one-half of the sulphur that was saved.

Importance of Sulphur To-day

To-day sulphur, as brimstone and all the various chemicals derived from it, is the most widely used chemical in the world, and the consumption of material and derivatives is measured in millions of tons a year. Up to the end of the nineteenth century Italy, partly with her old methods, but latterly by improved methods of mining and smelting, whereby more of the sulphur was recovered, continued to supply the bulk of the world's consumption. By 1905, however, America had come into the world field with production by special methods of



VIEW OF WELLS DISCHARGING.
(*Texas Gulf Sulphur Co.*)

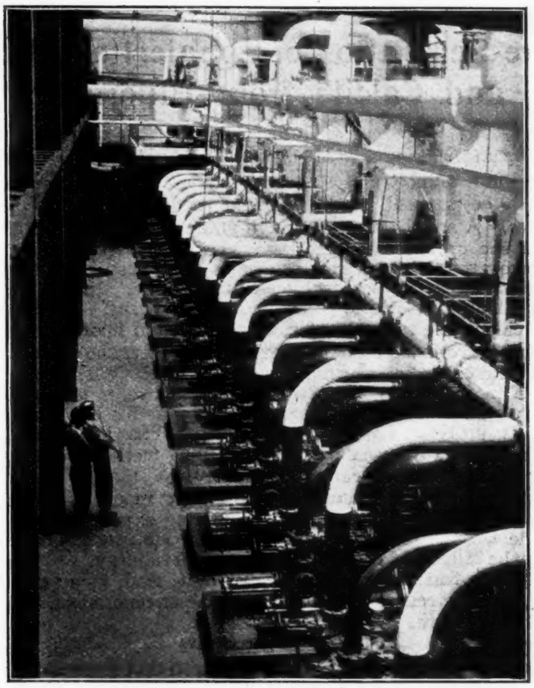
mining from the vast underground deposits located on the Gulf Coastal Plain. Some of these deposits are of immense size, the largest probably being that worked by the Texas Gulf Sulphur Co., at Matagorda County, Texas, which contains upwards of 10 million tons of sulphur; it is known as the Big Dome, and in 1920 produced approximately 1,000,000 tons.

The Big Dome at Matagorda

The Dome at the surface of the ground is some two miles across, or three square miles in extent, and rises at its highest point to only about 10 ft. above the surrounding plain. Slight as this surface characteristic is, it seems to persist down through all the strata of the earth at this point. Going down from the top, successive layers of top soil, gumbo, sands and gravels are passed through for several hundred feet, then a layer of limestone of peculiar formation. This forms the cap-rock or cover over the mixed lime rock and sulphur deposit just below, from which the sulphur is mined. Below this, in turn is a layer or strata of gypsum, or calcium sulphate, and below the gypsum lies a thick deposit of rock salt, from which comes the name "Saline Dome" that is applied to the mound.

Method of Mining Sulphur

To mine the sulphur at the Texas Gulf Sulphur Company's mine a well is sunk to approximately a thousand feet, the right depth being determined by the drillers in each case. The



MINE PUMPS AND HEATERS.
(*Texas Gulf Sulphur Co.*)

well is equipped with a system of pipes one inside the other, and "superheated water," or water at the temperature of high-pressure steam, is pumped down between the pipes. This melts the sulphur in a large area around the well, and it flows into a pool at the bottom, where it enters a pipe provided to take it to the surface. The pressure of the thousand feet of water in the pipe, added to the pressure applied at the casing-head by the mine pumps, raises the sulphur several hundred feet in the pipe, and the air left is used to bring the melted sulphur to the surface as a golden stream 99·5 per cent. pure. The product is entirely free from arsenic, selenium and tellurium, and some of the Big Dome Wells are yielding at present a material testing as high as 99·9 per cent. sulphur, as calculated on a moisture-free basis.

Storing and Shipping Sulphur

At the surface, bins of various sizes, say one hundred and fifty by two hundred and fifty feet, are built by covering over

this area of ground with heavy tongue and groove flooring and putting up board sides. These retain the thin layers of sulphur that flow from the pipe emptying into the centre of the bin, until they solidify. In this way blocks of sulphur forty to sixty feet high are built up, containing seventy-five thousand to one hundred thousand long tons each. When one has been completed it is allowed to cool for a period, then the sides are taken off and the sulphur is blasted down to be loaded into cars by steam shovels.

Large Problems to be Met

This kind of mining is quite different from that employed in any other sulphur field. It requires large quantities of water from an unfailing source, great boiler plants to "super-heat" it, and numbers of large specially-designed pumps to send it down into the wells. As these wells are constantly going out of commission through exhaustion of the sulphur around them or accident, it is necessary that drilling operations be carried forward continually on a very large scale, and a large number of wells must be held in readiness to be put in commission, so that production can be maintained or increased if desired. Such operations can only be carried forward by a large organisation backed by great capital, and since the development of these modern efficient methods, the digging of sulphur from sweltering pits by manual labour has practically ceased, for that kind of production cannot compete in any important market.

The Separation of Sphalerite, Silica, and Calcite from Fluorspar

By John Gross

(*Metallurgist to the U.S.A. Bureau of Mines*)

SOUTHERN Illinois and Kentucky are credited with approximately 90 per cent. of the fluorspar production of the United States. A small amount of high-grade acid spar is obtained from the ore by hand sorting; the greater part, however, is recovered by jigs and tables as gravel spar containing approximately 85 per cent. calcium fluoride. In the jigging and tabling operations, galena is recovered, and enough silica and calcite are removed to raise the calcium fluoride content of the gravel spar to 85 per cent. However, the removal of silica and calcite results in a large loss of spar. With increasing depth in the mines, zinc sulphide, sphalerite, is encountered in increasing quantity, and the removal of this has become a serious problem. While the sphalerite can be fairly well removed from the spar by present milling methods, a marketable zinc concentrate cannot be made.

The experiments described below were made on fluorspar ore from Southern Illinois by the mining experiment station of the U.S. Bureau of Mines, at Rolla, Mo., in co-operation with the Missouri School of Mines and Metallurgy.

The ore tested contained 7·3 per cent. lead, 27·9 per cent. zinc, 35·7 per cent. calcium fluoride, 9·5 per cent. silica, and 4·7 per cent. calcite.

Tests and Results

In some preliminary tests it was noticed that a portion of the finely crushed ore adhered strongly to the sample pans, and upon investigation it was found that the adhering material was practically clean spar. By utilising this property of adhesion 46·8 per cent. of the spar was recovered as a product containing 98·3 per cent. calcium fluoride. This suggested the possibility of using electrostatic separation.

The results of numerous tests by electrostatic separation demonstrated that the sphalerite could be separated as a marketable product. That this separation could be made was well known, but it was discovered that the silica and the calcite could also be separated electrostatically from the fluorspar. It was also demonstrated that a copper-sulphate treatment of the ore before electrostatic separation resulted in a higher recovery of zinc as well as making a higher-grade concentrate. It is supposed that the effect of copper sulphating is to form a thin coating of copper sulphide on the sphalerite. This reaction is very rapid even in weak solutions. It was found that very weak solutions acting on the ore for 15 minutes gave as good results as strong solutions acting on the ore for hours. It was satisfactorily demonstrated that the consumption of crystallised copper sulphate need not be more than 1¼ lb. per ton of ore.

The results of the tests indicated that the best results are obtained by the following procedure: Wet-crushing to 10 mesh, classifying for table feeds and to remove slime, tabling to recover lead, copper sulphating, drying, screening to minus 10 plus 20 mesh, minus 20 plus 48 mesh, and minus 48 mesh; followed by electrostatic treatment of these three sizes, yielding zinc concentrate, fluorspar and tailing.

The treatment of this ore by the method outlined above resulted in the recovery of 57·8 per cent. of the zinc in a 57·4 per cent. zinc concentrate and 65·4 per cent. of the fluorspar in a 98·7 per cent. calcium fluoride product. Spar 98·7 per cent. pure is of acid or enamelling grade, and commands a much higher price than gravel spar. This should justify the increased costs of treatment.

It was found that electrostatic treatment of the slime is not feasible, owing to the incomplete separation and the difficulty of thorough disintegration of the dried slime. A good grade of zinc concentrate, however, can be recovered from the slime by flotation, but the spar product, or flotation tailing, contains only 73 per cent. calcium fluoride.

The flotation of the slime resulted in 15·8 per cent. additional recovery of zinc, and flotation of the low-grade zinc concentrate from the retreatment of tailing resulted in 12·2 additional recovery of zinc. The total zinc recovery by electrostatic separation and flotation was 85·8 per cent. in a 58 per cent. zinc concentrate. The total fluorspar recovery would depend on the grade desired. A recovery of 73·6 per cent. of the spar as an 89·2 per cent. calcium fluoride product was obtained.

As regards the lead, the results of a series of tests by electrostatic separation of this ore showed that 72·3 per cent. of the galena was kept out of the zinc concentrate when copper sulphate was employed, and only 18·9 per cent. was thus removed when copper sulphate was not resorted to.

Concentration by Flotation

Tests by flotation on this ore, after removal of the lead and a portion of the silica and the calcite by tabling, showed that a high-grade zinc concentrate could be made but the spar product is low-grade. When ground to 65 mesh a recovery of 96·7 per cent. of the zinc was obtained in a 59 per cent. zinc concentrate and 94·3 per cent. of the fluorspar in a 77·6 per cent. calcium fluoride product. It was found that the slime or colloidal material in the flotation feed resulted in lower-grade zinc concentrate. When treating this ore by flotation the tailing must be considered as the spar product, and the silica and the calcite in the feed will therefore be found in the spar. In order to obtain a marketable spar product by flotation, it is necessary to remove silica and calcite by table concentration, and this can be done only with a considerable loss of fluorspar, owing to the slight difference in specific gravity. That a portion of this fluorspar lost by table concentration is recoverable by electrostatic treatment was demonstrated by recovering 12·1 per cent. of the spar in a 95·5 per cent. calcium fluoride product.

Conclusions

A comparison between electrostatic separation and flotation results leads to the conclusion that flotation will yield a slightly higher-grade zinc concentrate with a much higher recovery, but that a marketable spar can be obtained by flotation only by sacrificing a large amount with the silica and the calcite discarded on the tables, while practically any grade of spar can be obtained electrostatically.

The crushing of the ore to 10 mesh for electrostatic separation instead of to 65 mesh for flotation is greatly in favour of electrostatic separation.

The copper sulphating of the ore, which is done after the table concentration and before drying, is not expensive.

While flotation will give a slightly higher-grade zinc concentrate and a greater recovery, this is partly overcome by a better market price for the electrostatic zinc concentrate, owing to its coarser condition.

The drying of the ore before electrostatic treatment is not so difficult or expensive an undertaking as the drying of both the flotation concentrate and the tailing (spar).

More machines will be required for the electrostatic separation, with consequent increase of floor space, than for flotation.

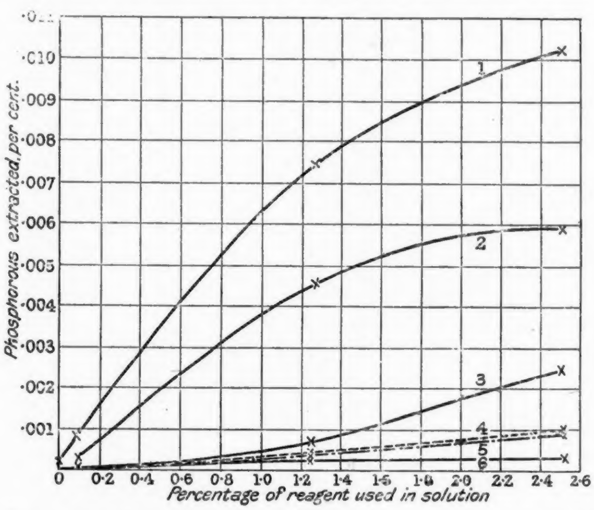
As there seems to be considerable doubt among mining men as to the reliability of operating electrostatically in wet weather, it is suggested that before an electrostatic installation is decided upon a machine be tried on a working scale under all possible conditions.

Leaching Iron Ores for Phosphorus

By R. M. Winslow

(Junior Analytical Chemist to the U.S.A. Bureau of Mines)

THE phosphorus content of an iron ore is a determining factor as regards the value of the ore and also its metallurgical treatment. If some method of treatment, such as concentration, leaching, etc., could be used and the phosphorus content of the ore reduced, it would be an important advancement in the iron mining industry towards the utilization of high phosphorus ores. Large bodies of material too high in phosphorus to be marketable under present conditions would be made available, and a great deal of ore from the Cuyuna Range, which is relatively high in phosphorus but otherwise suitable for making spiegel, could be reduced in phosphorus content sufficiently to permit its use in furnaces producing spiegel. The statement has been made that ore piles on long exposure to the atmosphere often decrease in their phosphorus content. (Emmons, S. F., "Ore Deposits," 1913, p. 652; Leith, C. K., "Mesabi Iron-bearing District," U.S.G.S., Monograph 43, 1903, p. 275.) There are described below experiments on the leaching of iron ores high in phosphorus, to determine whether it was economically possible to reduce the phosphorus content appreciably by leaching. As the research had a practical as well as a theoretical application, only low concentrations of acids and alkalies were used.



CURVES SHOWING EFFECT OF THREE MAIN VARIABLES—SOLVENT USED, STRENGTH OF SOLVENT, AND TYPE OF ORE.

Curve 1, sulphuric acid and brown ore; Curve 2, sulphuric acid and Cuyuna ore; Curve 3, hydrochloric acid and brown ore; Curve 4, hydrochloric acid and Cuyuna ore; Curve 5, nitric acid and brown ore; Curve 6, nitric acid and Cuyuna ore.

Description of Method Used

One hundred grams of the ore was agitated in the solvent for the required length of time by slow shaking in a shaking machine. It was then allowed to settle overnight, the supernatant liquid decanted off, and the remainder of the solution filtered through a close filter. The filtrate was evaporated on the hot plate and when reduced to about 100 c.c. in volume, was transferred to a tarred dish, evaporated to dryness and weighed as sulphates. The increase in weight gave the total dissolved material. After weighing it was dissolved in concentrated HCL and again taken to dryness to remove all the silica; again dissolved in concentrated HCL, diluted and filtered. The paper was ignited and the silica determined. The filtrate was made ammoniacal, bromine added, and the total oxides precipitated. These were filtered off, ignited, weighed and reported as total oxides. The total oxides were then dissolved in concentrated HCL, concentrated HNO_3 added, and evaporated to scum of HNO_3, and P precipitated as yellow phosphorus and determined by alkali titration method.

Solvent.—Low percentages of the mineral acids, hydrochloric, nitric and sulphuric, were the principal solvents used. Other solvents tried were sodium hydroxide, tap water citric acid and ammonium citrate.

Strength of Solvents.—The mineral acid solutions were varied from 0·1 to 2·5 per cent. acid. The sodium hydroxide solutions varied from 0·2 to 0·8 per cent. base. Two per cent. citric acid and ammonium citrate solutions were used.

Volume of Solution Used.—As the amount of ore used was kept constant at 100 grams, the change in volume of solution used also represents the relative percentage change. Two volumes were used, 400 and 650 c.c., or 80 and 86·6 per cent. solution.

Time Ore was Agitated.—The length of time the ore was shaken varied from two to ten hours. All samples were allowed to settle overnight, and the clear liquid then decanted off.

Type of Ore.—High phosphorus ore containing between 0·2 and 0·12 per cent. P was used, the main work being done on a Cuyuna ore of this type.

Screen Size of Ore.—Two sizes were tried, 100 and 300 mesh; all but a few experiments were made on 100-mesh ore.

Of the above variables only three proved to be of importance. These were the solvent used, the strength of the solvent, and the type of ore.

The more finely divided ore gave slightly higher results, as would be expected, but since anything below 100-mesh is too fine for practical purposes, these results were of comparative value only. The volume of solution seemed to have very little effect, even when the low concentration of acid was used. The length of time the mixture was agitated had little more effect than the volume, although its effects were noticeable on the low-acid concentrations.

The effect of the solvent used was the most important of these noted, aside from the type of ore. Sulphuric acid proved to be the best solvent, while hydrochloric was the poorest. This superiority of sulphuric acid holds true in three respects. It removes the greatest amount of phosphorus, removes considerable silica, thereby concentrating the ore, and is the cheapest solvent used. It has two disadvantages—it dissolves a little more iron than the other solvents, but this is under 1 per cent. maximum, and some means must be used to insure that the acid will not be reduced or decomposed in smelting with the consequent increase in the sulphur content of the ore and pig iron. Sodium hydroxide gave the second best results. However, treatment with this solvent left the ore in such a slimy condition that it would be next to impossible to handle on a large scale. The nitric acid and hydrochloric acid and the citrates gave very low results, but served to show the effect of the other variables.

The amount of phosphorus dissolved was greater in all cases with the higher concentrations of the solvents, showing that equilibrium was not reached. As only three points on the accompanying curve were determined and the percentages of phosphorus extracted were so low, the chance for experimental error was large, so that no conclusions can be drawn as to the exact shape of the curve. This probably could be determined by trying higher concentrations of solvents, but the use of stronger concentrations is impracticable as regards commercial applicability, and was omitted.

The greatest variation in results was with the type of ore used. Two types were studied—a brown ore, phosphorus 0·124 per cent., range not known, and a Cuyuna ore of approximately the same phosphorus content. Under identical conditions the phosphorus extracted with both HCL and H_2SO_4 was nearly twice the amount from the brown ore as from the Cuyuna ore. This is probably due to the form of the phosphorus in the ore, which, as already stated, is uncertain.

The maximum extraction of phosphorus by leaching was obtained by using 2·5 per cent. H_2SO_4, with a ratio of solvent to solution of 4 to 1 and constant agitation for 6 hours, on the brown ore. In this particular test 0·0102 per cent. P was extracted from the ore, which contained 0·124 per cent. P, or 8·2 per cent. of the phosphorus was leached out. It is evident that this is a negligible percentage from a commercial view-point. In addition, the fact that the cost of the acid alone used would be approximately $0·45 per ton of ore treated makes the results doubly negative, especially when phosphorus can be removed in the open hearth for a fraction of this cost. The conclusions to be drawn, then, are that while the leaching of phosphorus from iron ores presents many points of scientific interest, the method is not commercially feasible —(*U.S. Bureau of Mines, Reports of Investigations.*)

Mining and Metallurgy in South Africa

By W. Cullen, M.I.M.M.

The writer gives an interesting account of the mineral resources of South Africa. The effect of the war on the gold and other industries is discussed and attention is given to enterprising schemes for development which are now in hand.

MINING all the world over is at present in the doldrums, and there is no immediate prospect of a revival. It is not surprising, therefore, to find that South Africa is suffering in common with other countries, but not so much as most, for gold is still the staple mining product, but its present uneven stability is based entirely on the gold premium which is now in the neighbourhood of 30 per cent.—that is, the price now obtained is 30 per cent. over the standard price of 85s. per oz. of fine gold. It is safe to say that if by a miracle the price were suddenly to revert to the normal, about three-fourths of the gold mines would have to close down. It is, of course, the same old story over again. Wages have risen out of all proportion to the value of the product and this, coupled with great and ever-growing inefficiency on the part of the workers, has brought about a condition of affairs which is the reverse of healthy. True, wages have gone back a little, but further reductions will have to be made before the British investor can be tempted to look at " Kaffirs." The statistics of production for last year show a drop of five million sterling since the record year 1916. It may be interesting to state that the 1920 output was won from the stupendous total of 24 million tons of ore. Five companies each crushed over one million tons and one (the Crown Mines) crushed over two million tons. The average grade was only 6·5 dwt. per ton, and the average profit 9s. 7d. per ton, of which it is safe to say that three-fourths was due to the gold premium. To-day, the Transvaal is responsible for exactly one-half of the world's gold production, and if Rhodesia is included the percentage is considerably higher, for Rhodesia is now fifth or sixth among the gold-producing countries of the world.

This is not the place to record departures from standard mining practice, if indeed there is such a thing, but it may be mentioned that several mines are now drawing their ore from sea level. Johannesburg stands at approximately 6,000 ft. above sea level. So, in other words, mining is now carried on at a depth of 6,000 ft., which only a few years ago would have been reckoned an impossible operation, and preparations are now being made to mine at 7,000 ft.

Deep Mining

This deep mining has brought about all sorts of problems, and it cannot be said that they are yet solved. The most important of all, the economic one, is in a state of flux.

Turning to the metallurgical side of gold, there have been no startling developments for years., Indeed, since the introduction of the tube mill, about 15 years ago, there have been no epoch-marking developments. True, plant has been improved, mechanical devices have been perfected, extraction has increased by several per cent., and, generally speaking, the size of metallurgical units has been increased, but the changes introduced have all been along the lines of evolution rather than on departure from traditional practice. Within the last few months, however, Mr. Carl Davis, consulting engineer to one of the most progressive groups, has demonstrated on a very large scale that the heavy gravity stamp can be dispensed with altogether. What this means in practice may be illustrated by the fact that present-day stamps can break 30 tons of rock per day in a form suitable for subsequent treatment in tube mills. Mr. Davis claims that all this work can be done more economically by rock breakers and tube mills, and that even if there is no saving in operating expenses, a very considerable saving on capital account can be effected. It takes over one mililon sterling to-day to erect the surface plant of a modern standard gold mine.

The Rand is probably the most concentrated mining field in the world, consequently comparative experiments can be conducted on a very large scale, and as a rule the results of those experiments are pooled, which is, of course, a good thing for the industry. Quite early in 1914 it was recognised that glycerine was one of the most important raw materials for war purposes. In consequence of this, every endeavour was made to curtail its use, particularly for mining explosives, but nitro-glycerine associated, of course, with other bodies, is still the best all-round blasting agent. Twenty years ago or thereabouts, blasting gelatine—nitro-glycerine gelatinised by collodian cotton—was practically the only blasting agent used in the gold mines. Weaker explosives were used in other mining fields, but the very hard conglomerate of the Rand withstood them all. The net result of the war experience is worth recording, for not only throughout the British Empire but throughout the world, nitro-glycerine has been very largely replaced by other bodies with equally good results on the economic side of mining. There will, in future, therefore, be a much lessened demand for glycerine, for in the past the manufacture of explosives has absorbed the bulk of the world's production of this article. Cheap explosives are absolutely necessary for cheap coal production, for 20 per cent. of the actual expenses of " coal getting " is represented by explosives.

All the diamond mines of South Africa are at present out of business, and it will be many months and possibly years before the world can absorb the stocks of diamonds now on hand. The demand to-day is negligible, notwithstanding the fact that the Antwerp cutters are reported to be busy, and the market is certainly kept more than supplied by alluvial diggers, who earn a most precarious livelihood. Fifteen months ago there were thousands, possibly tens of thousands, of those men, many of them ex-soldiers. To-day there are not as many hundreds, and nothing that has ever happened in the past has done so much to upset South Africa financially, for the Government drew a large revenue in the way of direct and indirect taxation of the diamond mines.

South African Coal

Very little would have been heard of South Africa as a mining country had it not been for its abundant stores of cheap coal. The quality on the whole is none too good, the ash content being 12 per cent. and over, but this defect is amply atoned for by the price. In the Transvaal, even under to-day's conditions, the average pit-mouth price is only about 6s. per ton. In Natal the pit-mouth price is a few shillings higher, because the conditions are more difficult. Transvaal coal is mined at a depth of from 100 ft. to 200 ft. The total production to-day is at the rate of 11 million tons per annum, of which three-fourths are consumed in the country and the balance exported. It can readily be understood that the South African collieries did well during the war, and our recent coal strike did them no harm; but it ought to be stated that though during the war they could have got almost any price for their coal they did not profiteer, and on Armistice Day pit-mouth prices were only 1s. per ton higher than pre-war.

There seems no immediate prospect of a large by-product industry, though individual companies are nibbling. There are in operation two small coking plants, the coke being used for the production of pig iron; but until there is a prospect of establishing an iron and steel industry on a permanent basis, by-products must take a back seat. There are also in operation to-day two considerable steel-making plants; but their raw material is mainly scrap, of which there is an immense amount in the country. It can, however, be stated with a measure of certainty that, once things assume a more normal appearance, an iron and steel industry on a fairly large scale is bound to come, for South Africa has excellent iron ore and lime in abundance, and certain of the coals make quite a good metallurgical coke.

With the possible exception of Mexico, no other country in the world has such a wide range of mineral resources. Certainly they have not as yet been developed, and even under the most favourable circumstances, this will take many years ; but even in these difficult times the following are being worked presumably at a profit, or the mines and metallurgical works would have been closed—namely, tin, copper, lead, asbestos, chrome, corundum, mica and pig iron. Tin is found mostly in the Transvaal, but copper is more widely distributed,

though the well-known Cape Copper works are for the present closed down. Tanganyika hardly comes within the scope of this article; but it is worth noting that though most of the copper mines of the world have now stopped working, Tanganyika still continues, and that last month's production was almost 2,800 tons. The explanation is, of course, that it can be produced below the world's selling price, and this in spite of its great inaccessibility. Rhodesia is producing about 2,000 tons of lead per month, in spite of the low price which now obtains. Chrome and corundum are at present quiescent, and mica production has been curtailed. The same applies to asbestos, which is found exclusively in the Cape, Transvaal and Rhodesia. Indeed, the latter country is now the second highest producer in the world, Canada being an easy first; but it is safe to predict that at no distant date Canada will lose its proud position, for immense quantities of all the varieties are known to exist and only await exploitation.

Platinum and Nickel

Within the last eighteen months very rich discoveries of both platinum and nickel have been reported, and a considerable amount of development has taken place, but it is probably too early yet to state definitely that they will affect world production.

Apart from the Broken Hill Mine of Rhodesia, and another smaller one in the Western Transvaal, there are no large occurrences of zinc.

There are many other occurrences of a minor nature, but one which transcends all others is that of vanadium. At present an American corporation controls this metal, and steel makers here and elsewhere had to pay a very high price for their requirements during the war. The discovery of a very large and satisfactory supply within the Empire is therefore all the more gratifying, and it is hoped that, notwithstanding the bad times through which the steel trade is passing, the property will be secured for Empire steel. If control should go in the end to a foreign Power, it would be nothing less than a calamity.

Apart from the winning of gold and lead and a little tin, it cannot be said that metallurgy is highly developed in South Africa. As a rule the ores, after dressing, concentration or sorting, are sold through brokers, and in most cases their destination is quite uncertain. Even to-day all the refining of gold is done outside South Africa, and mostly in London. In a few months all this will be changed, for the mines have now erected a co-operative refinery, a section of which will be at work in a few months. This will be by far the largest plant of its kind in the world. Prior to the Boer War the Kruger Government had its own refinery and mint at Pretoria, but it has remained closed since the British occupation. Now, twenty years afterwards, a refinery is being started, the old mint is being equipped with modern machinery, and in a few months it should be going.

The Industrial Future of Electro-Deposited Iron

By W. E. Hughes, B.A. (Cantab.)

(Lately Chief Research Chemist, Electro-Metallurgical Committee, Ministry of Munitions)

One can always learn something from the past that will be of guidance for the future. This is true in general. It is equally true that the lessons taught by past failures and deficiencies are not always learnt, or, if heeded at all under some stress of necessity, are speedily forgotten. The electro-deposition of iron affords a particular instance of this general case. In the Annual Report of the British Association Meeting for 1869 there is to be found some account by M. H. von Jacobi of a process whereby iron was at that time being deposited at the St. Petersburg Government printing-press. This process was worked out by Jacobi himself in collaboration with E. Klein. Several years afterwards, Sir W. Roberts-Austen, then connected with the Royal Mint, discussed the process with Jacobi in London, and subsequently went to St. Petersburg to investigate it for himself. The result was that a Paper upon the subject was read at a meeting of the Iron and Steel Institute in 1887, in which Roberts-Austen commented most favourably both upon the process and the deposited metal. So far as can be ascertained, the matter ended with the publication of Roberts-Austen's paper—inasmuch this country is concerned.

It was different on the Continent. F. Haber,* S. Maximowitsch,† A. Russ and A. Bogomolmy,‡ H. Lee§—to mention only a few—all found it worth while to investigate the process of Jacobi and Klein; and one result was that it was developed and improved, and ultimately adopted and used industrially at the Government printing-press in Vienna.

Obituary Notes and Development

Something similar happened in the case of the work on electro-deposition of Alexander Watt on the one hand and of W. M. Hicks and L. T. O'Shea on the other. In the pages of *The Electrician* for 1887 and 1888 can be found a number of articles, written by Watt, containing detailed accounts of experiments performed by him in connexion with the deposition of iron from a large number of solutions of salts, both organic and inorganic. These articles contain a fund of information on their subject. Yet they seem to have become lost; they are not even noticed in one of the most recently published textbooks purporting to deal with electro-plating. The work of Hicks and O'Shea|| fared somewhat better—so far as textbook notice goes; but there has been no industrial outcome from it. Their results seem to be subject matter rather for obituary notices than for scientific and industrial development. In the interval between the publication of the work of Hicks and O'Shea in 1895 and the outbreak of war in 1914 only one paper of any note relating to the deposition of iron was published in this country, namely, that read by S. Cowper-Coles before the Iron and Steel Institute in 1908. This paper was concerned with the manufacture of iron tubes and sheets by electro-deposition methods. Criticism of Cowper-Coles' methods would be out of place here; but the paper is of present interest as indicating that the electro-deposition of iron and its commercial possibilities were not quite forgotten.

Position on the Continent

The position on the Continent and in America was very different. The science of the electro-deposition of iron was, during the same interval, fostered by F. Foerster, of Dresden, R. Abegg, H. Lee, R. Amberg, F. Haber, A. Neuburger, and many others; and the application of the scientific principles to industrial purposes was the object of persistent work by F. Fischer in Germany, C. F. Burgess and C. Hambuechen and also O. P. Watts in America, and by L. Guillet (among others) in France. Fischer* and Burgess and Hambuechen† developed processes whereby iron could be refined successfully by electrolytic methods; and Fischer and Guillet,‡ each of them, put the manufacture of iron sheets and tubes by electrolysis upon a commercial footing.

The Result of Neglect

The result of the neglect in this country of electro-metallurgy generally and of iron deposition in particular was felt shortly after the outbreak of war. Iron and steel soon became materials of such value that not even Government departments dared waste them, and it became necessary to find a means of avoiding the scrapping of aeroplane crank-shafts and other parts when these became worn down by a few thousandths of an inch. Someone conceived the bright idea of depositing iron on the worn surfaces, and thus bringing the articles up to gauge. No doubt the conception was formed in complete ignorance of the uses to which copper had been put for many

* "Zeit. f. Elektroch," 1898, Vol. IV., p. 410.
† "Zeit. f. Elektroch," 1905, Vol. XI., pp. 52 and 91.
‡ "Zeit. f. Elektroch," 1906, Vol. XII., p. 697.
§ "Abhandll. der deutsch. Bunsen-Gesellschafft," Nr. 2, p. 59.
|| *The Electrician*, Vol. XXXV., p. 843, 1895, and Assoc. Rep., 1895, p. 634.

* "v. D.R.P.," 1908, No. 212994.
† "Trans," Am. Electroch. Soc., 1904, Vol. V., p. 201; "Electrochem. Ind., 1904, Vol. II., p. 184; and see also "Trans." Am. Electroch. Soc., 1906, Vol. IX., p. 229, for an interesting account of the structure of deposits by Burgess and O. P. Watts.
‡ "Jour." Iron and Steel Inst., 1914 (No. 2), p. 66.

years past. In a short time captains and majors were appointed in several Government departments (each one working in ignorance of what the others were doing) to supervise processes they did not understand, while those few who did know anything of deposition were engaged either in other civil work or in the trenches. Consequently progress was slow. The idea was conceived, but the means of carrying it out were unknown. Credit is due to those engaged in the base work-

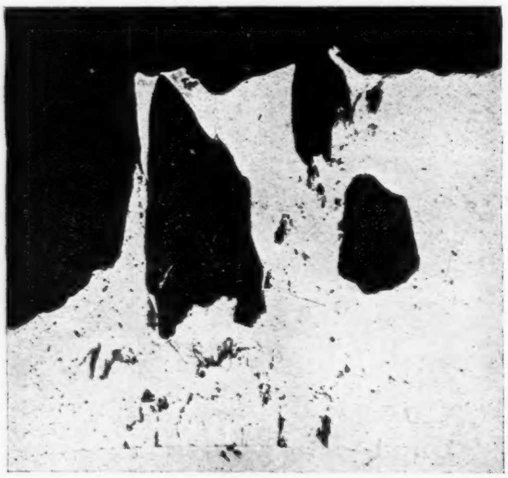


FIG. 1.—IRON DEPOSIT SHOWING LARGE HOLES AND NUMEROUS OXIDE INCLUSIONS × 50.

shops in France and elsewhere for succeeding, even partially, in doing deposition work of unknown quality; but it was not till towards the end of 1917 that Lieut. Emptage succeeded in depositing iron of more than two or three thousandths of an inch in thickness and at a reasonable rate. Naturally, having succeeded so far, Emptage was sent to another depot for other work than deposition.

The industrial future of electro-deposited iron depends, in

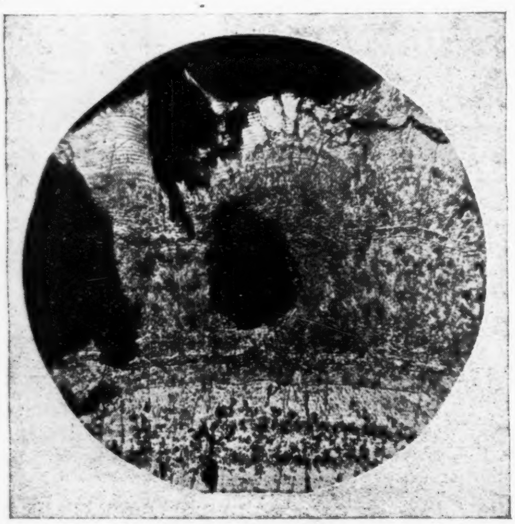


FIG. 2.—IRON DEPOSIT SAME AS FIG. 1, BUT ETCHED × 50.

the first place, upon how many of the lessons which can be learnt from the facts contained in the foregoing historical sketch have been learnt, the principal one being that electro-deposition, whether of iron or other metal, is not an art that "any fool" can compass. It is an art which is founded on scientific bases, and if new electrolytic processes and methods are to be applied successfully to economic purposes, careful scientific work must be done beforehand.

Scientific Control of Deposition

It is one thing to deposit a metal; it is quite another thing to deposit metal that is to be of any use for a given purpose. To attain this latter end, the process of deposition has to be under scientific control. It must be known what particular set of deposition conditions must obtain in order to produce a given result. Moreover, the result must be known in a scientific sense—the structure and properties of the deposited metal must be known, together with the defects to which it is liable. The industrial future of electrolytic iron depends upon the acquisition of this knowledge, which is, as yet, only in part attained. The writer was sent a sample of deposited iron some little time ago. The sample came with a covering letter that was a veritable song of triumph. The deposit

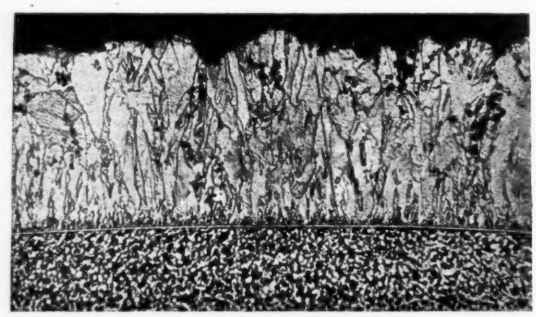


FIG. 3.—IRON DEPOSIT SHOWING "NORMAL" STRUCTURE × 100.

was some 0·12 in. thick, and, casually examined (especially by a layman), seemed very fair. The photo-micrograph, Fig. 1, shows the polished, unetched surface of a cross-section of it: the etched surface is seen in Fig. 2. The sender was proud of the thickness of iron he had deposited: that was all he *knew* about it. The deposits seem to be full of large holes and to contain innumerable cracks and many small dark patches of inclusions of iron oxide. J. C. W. Humfrey has aptly described a similar deposit as "rotten."* It is utterly

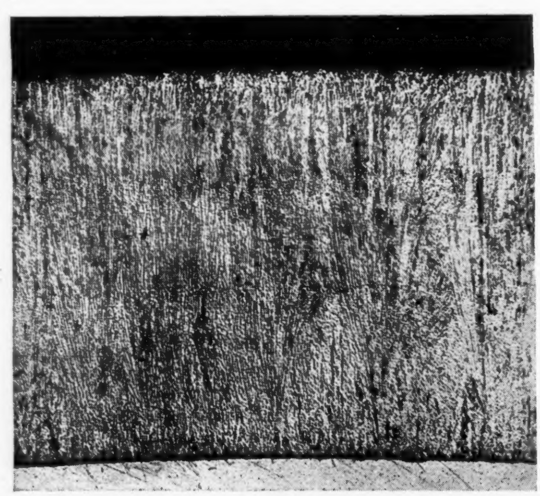


FIG. 4.—IRON DEPOSIT SHOWING EFFECT OF ACID ON STRUCTURE × 156

useless for any purpose whatever; it was under no sort of scientific control during its formation.

To illustrate the statement made above in regard to the importance of a knowledge of the structure of the metal deposited, attention is directed to the micrographs, Figs 3

* "Carnegie Scholarship Memoirs," 1912, Vol. IV., at p. 82.

and 4. Fig 3 (for the reproduction of which we are indebted to the Beama *Journal*) shows the structure of what may be called a "normal" deposit of electrolytic iron, or one formed in a neutral solution and without movement either of the cathode, anode, or solution. Fig. 4 shows the difference of structure brought about by employing an *acid* instead of a *neutral* solution. It will be evident that, since difference of structure involves difference of properties, a deposit having the structure shown in Fig. 3 might be desirable in one case while one having that shown in Fig. 4 might be the requisite in another. Other factors of deposition—current density, concentration of metal content of the solution, agitation of the electrolyte by mechanical or other means, and even temperature—affect the structure of the deposited metal in various ways and degrees. So much is this so that a practised electrometallurgist can, after examination of it with a microscope, give at least a general history of the formation of a deposit, in the same way, but not in the same detail, as a petrologist can describe the history of the formation of his igneous rocks.

Scientific control is important in all deposition processes, but it is, perhaps, more important in the case of iron than in the cases of other metals. Iron brings the electro-metallurgist into close touch with the engineer, both mechanical and electrical; and the industrial future of electrolytic iron depends to no inconsiderable extent upon how far the electrometallurgist can satisfy the demands and requirements of the engineer. To give the engineer what he wants, the electrometallurgist must know the means of doing so; and to know these he must be able to correlate conditions of deposition with structure.

Important Factors

Factors of great importance to the industrial future of deposited iron are that there should exist solutions from which satisfactory deposits can, under proper conditions of control, be obtained, and that these solutions should be capable of fast work and be as economical as possible in the matter of high current efficiency. Two solutions are known that fulfil the necessary requirements: one is of the chloride,* the other of the sulphate type,† and both have been put to practical test in industry. The chloride bath consists of a highly concentrated solution of iron (ferrous) and calcium chlorides. It is worked at a temperature between 90° C. and 110° C., and at a current density of anything up to 180 amperes per square foot. The sulphate bath, analogous to the chloride as regards the principles underlying its composition, consists of a concentrated solution of sodium and ferrous sulphates. This bath is worked at or near boiling point, and at a high current density. Both baths are neutral in reaction. The chloride bath is the older, and has been used commercially for a number of years, both for refining iron and for the manufacture of iron sheet. The iron obtained from it is of great purity (99·98 per cent.)‡: it is soft and malleable, and it forms excellent material for use in the manufacture of parts of electrical machines.§ The sulphate bath, which is newer, has not been put to the same severe test as the chloride. But Max Schlötter, the patentee and an authority on the electrodeposition of metals, states that the deposit is very pure and contains but little hydrogen. It may be added that the cathode efficiency of both these baths is very high.

A third solution, which is one of the sulphate type, has stood the test of time as an electro-refining bath. This is the one used by Burgess and Hambuechen since as long ago as the early years of this century. The electrolyte in this case "consists of ferrous and ammonium sulphates; the current density of the cathode is 6 to 10 amperes per square foot of cathode surface, and at the anode slightly less; the E.M.F. for each cell is slightly under one volt; the temperature of the electrolyte is about 30° C."; and "the current efficiency of deposition is very closely 100 per cent." This bath differs in composition from the two before described: the deposit is hard and brittle, but this does not much matter in the case of a refining bath—purity is the great requisite here. There is, too, a great difference in the rate of working, which is of importance inasmuch as the greater the current density employable, the greater, *ceteris paribus*, the output obtained, and, hence, the fewer in number (or smaller in size) the vats required for a given output. It is in this respect—rate of working—that the iron solution used by Burgess and Hambuechen is inferior to the baths of Fischer and Schlötter respectively.

The Present Position

As shown in the foregoing, a principal requirement for the industrial future of electro-deposited iron, namely, a satisfactory solution, may be fairly said to be satisfied. Work has recently been done in the direction of obtaining such scientific control of the actual deposition that the product desired can be obtained with certainty. The writer has been privileged to help (if ever so little) in this part of the work, and can say, of his own knowledge, that the conditions of deposition that will lead to the formation of iron deposits possessing this or that characteristic structure and definitely desired properties are known in general, at least, if not in very great detail. It follows that by intelligent, informed practice the engineer or manufacturer can be given deposited iron that has properties that are required in the metal in a particular case. This advance ensures that the terms "experiment" and "experimental," which in the mind of many a manufacturer are associated with depletion rather than the inflation of this bank balance, will not appear so harshly and vividly in his imagination. He will, therefore, be much more likely to use electrolytic iron for one purpose or another than if preliminary experiment were necessary before what he requires can be supplied to him; and this is good for the industrial future of electro-deposited iron. Further, there are signs that the lessons to be derived from the former neglect in this country of electro-metallurgy have been partially learnt; and this fact engenders a hope that research upon both the purely scientific and the applied sides of this science will be fostered.

Research Work in London

Research work has certainly begun. But one finds that in Birmingham—the very centre of applied electro-metallurgy—the University lectureship, once held by McMillan, has fallen into desuetude, though in Sheffield and London research is being encouraged. At the East London College the authorities have promoted research upon the microscopic study of deposited metal by placing at the disposal of a research worker the splendid photo-micrographic outfit in the Engineering School. At the Royal School of Mines, Imperial College, active work is being initiated under the supervision and guidance of Prof. H. C. H. Carpenter, F.R.S., who, for a considerable time past, has taken a lively interest in electrometallurgy, and who is one of the few men of science of eminence in this country who is a firm believer in the great future of the subject.

In yet a third way research upon electro-metallurgy has been of recent years encouraged. For some while now the Scientific and Industrial Research Department has allotted funds for carrying on research on the subject. In all fairness it ought to be mentioned that the freedom of action and of choice of subject allowed to the allottees of the grants has proved quite the contrary to the restricting procedure alleged by certain individuals to be characteristic of the work of the Department. It will, thus, appear that the hope expressed above is based upon substantial foundation. It remains for the manufacturers and engineers in this country to make use of the work that has already been done in several directions upon electrolytic iron, and thereby to indirectly, if not directly, promote and encourage future work. This has been done elsewhere—in France, Germany, and America—for such a considerable time past and on such an extended scale as to justify the inference that the employment of deposited iron is of value in several directions in industrial work. The industrial future of deposited iron certainly depends to a considerable extent upon the overcoming of some initial, not, perhaps, inexplicable prejudice and doubt on the part of industrial users. Once such doubt and prejudice, in so far as they arise from the conscious or sub-conscious fear of the terms "experiment" and "experimental," are allayed, there is no doubt that the present-day applications of deposited iron (several of which have been mentioned in this article) will be speedily and widely extended and that new uses will soon be found for the metal.

* "D.R.P.," 1908, No. 212994.
† "D.R.P.," 1917, No. 309271.
‡ "Pfanhauser, Galvanotechnik," 1910, p. 750.
§ C. Duisberg. Internat. Congress of App. Chem., 1912, Vol. XXVIII., p. 60.

Safeguarding of Industries Act

Opinions of Manufacturers and Traders

WITH a view to eliciting the opinions of firms engaged in industries affected by the Safeguarding of Industries Act, a representative of THE CHEMICAL AGE found that a great deal of exception was taken in many quarters to the schedule of dutiable goods issued by the Board of Trade. The proprietor of an old-established trading business said in this connexion that it was "absolutely impossible for a country of the size and situation of Great Britain to ever become a great manufacturing centre. We have," he pointed out, "been dependent not so much on the goods we manufactured as on the goods we handled in this country. If we wanted to take up new manufactures," he continued, "we should first find a market and then prohibit the importation of this product into Great Britain until such time as we were able successfully to meet foreign competition. We should also learn to adapt ourselves to the requirements of the world's markets, and if we found ourselves beaten by a certain product of foreign manufacture in a certain market, we should utilise our brains and initiative to discover a new product to supersede it. There was no more dangerous policy than that of trade within the Empire alone as nothing was more likely to lead to international strife and bloodshed. The only remedy for the present state of affairs suggested to our representative was "the total abolition of all Government control on trade. Those officials who were responsible for the framing and supervision of the Act had," he concluded, "no conception of the wide field affected by their restrictions."

Customs Delays

Another merchant firm expressed itself as being opposed to any measure which will restrict trade in any shape or form. The Safeguarding of Industries Act, they maintained, had restricted trade very considerably, even in the short period in which it had been operative. The Customs delays, which are inevitable under the Act, were, in their opinion, one of its worst features, as most of our success as a collecting and distributing centre has been due to the rapid transit of goods. The necessity for the attendance of the importer or his deputy to clear his goods through the Customs was a very irritating and tedious business, wasting both time and money. They also alluded to difficulties which were likely to arise owing to overlapping in the Board of Trade classification. Acetic acid and acetone were quoted as a typical case. The former was made both synthetically from calcium carbide and from wood distillation, the latter from acetic acid or by fermentation. It was, they said, impossible to discriminate between cases like this, as the chemicals did not vary in properties with the method of manufacture.

Duroglass, Ltd.

An official of Duroglass, Ltd., of 40-43, Norfolk Street, W.C., said Part I. of the Key Industries Bill only came into effect on October 1, and it was impossible at this stage to say what the permanent effect would be. "The foreign exchanges are so unstable and the depreciation of certain European currencies so great that a duty of 33⅓ per cent. does not have a very material effect. In addition dealers have accumulated stocks prior to October 1 with the aim and object of avoiding the payment of the duty. Even when Part II. of the Key Industries Bill becomes operative, on tubing and scientific glassware, the additional 33⅓ per cent. will not counter-balance the depreciation in currencies, although, of course, it will help to decrease the present difference in prices.

"The position of British glass manufacturers and the labour that they employ is still precarious. It seems a most extraordinary thing that orders should be placed abroad and unemployment caused in this country. It is quite a fallacy to think that the goods are really cheaper, because one pays the difference in taxation, as the Government require to institute measures of relief and to pay doles. Without doubt English works have received more inquiries since the beginning of October, and I, personally, anticipate that these inquiries will increase and that orders will follow. There are, of course, quite a number of consumers who place their orders for British goods, and who will not take German goods at any price. One must feel sympathy with the scientist who, in the face of heavy taxation and meagre salary, goes to the cheapest market.

"The British manufacturers will be able to reduce their prices as soon as they can increase their output, and if it were not for the depreciated exchange, British prices would be below the Continental. This country has followed a policy of deflation—Germany one of inflation. The time must come when Germany will repudiate her debt or else start a policy of deflation. When that does happen British goods will be cheaper than the Continental, and if sufficient support is extended to the British works at this stage, it should be possible for British manufacturers to meet the demand for British goods which will then spring up.

"During the last twelve months the efficiency of the scientific and illuminating glass industry has increased tremendously, and if scientists as a body would order British goods, prices would gradually come down. British manufacturers do not ask their staff or workpeople to work 12 hours a day, six days a week, for 30s. a week; and that is what the Germans are doing. All British chemical glass manufacturers employ chemists, but they do not ask them to accept a salary corresponding to that which the German chemists accept. The British standard of living is above the German standard. In difficult times like the present, we should all pull together with a view to helping all individuals to sustain a decent standard of living rather than force them into the position of accepting doles."

Mr. E. B. Cook, a director of Johnson & Sons (Manufacturing Chemists), Ltd., Cross Street, Finsbury E.C., said that in his opinion the measure would be of considerable assistance to British chemical manufacturers, as they would now be able to look round, and make arrangements for the manufacture of new products which had not previously been manufactured in this country. In this connexion Mr. Cook pointed out that in a number of cases chemical manufacturers who during the war had to put down special plant for the manufacture of a particular product, would now be able to utilise practically the same plant for the manufacture of additional new products. Although the present value of the German mark did not at the present moment afford as much protection as it was intended it should do, the present state could not possibly go on very much longer. Mr. Cook said that Johnson & Sons had already started the manufacture of new products and hoped eventually to be able to manufacture the whole range of fine chemicals.

Inquiries made at the offices of British Drug Houses, Ltd., Graham Street, E.C., elicited similar information with regard to the manufacture of new products, but it was pointed out that British manufacturers could not immediately start making all the chemicals included in the Board of Trade's list. Time and research was in some cases necessary in order to arrive at the best and most economical method of manufacturing additional products at a really competitive price.

Ethylene from the Hydrogenation of Acetylene

IN an article in the *Journal of Industrial and Engineering Chemistry* on the Preparation of Ethylene by the Hydrogenation of Acetylene, W. N. Ross, J. B. Culbertson and J. P. Parsons state that metallic nickel reduced from the oxide at 300 deg. has a greater capacity than coconut charcoal for adsorbing hydrogen at ordinary temperature. When a mixture of equal volumes of hydrogen and acetylene is passed into an evacuated tube about one-third filled with freshly reduced nickel, the hydrogen adsorbed in the nickel, together with that added, may be sufficient to bring about the complete reduction of the acetylene to ethane. They find that by repeating the process of evacuating the tube and passing in the hydrogen-acetylene mixture until the excess of hydrogen is used up, a product may be obtained which contains upward of 80 per cent. of ethylene. A comparatively small variation in the composition of the mixture taken produces a considerable change in the composition of the recovered gas. The best results, the authors state, seem to be obtained when the hydrogen in the mixture is slightly in excess, but as this is further increased the ethylene decreases, with corresponding increase of ethane. As the acetylene in the mixture is increased the ethane in the product decreases, and the sum of the ethylene and acetylene increases. The adsorbed hydrogen in an active nickel catalyst may be eliminated without destroying its activity by repeated treatment with acetylene. The catalyst is then without action on either ethylene or acetylene.

In conclusion they describe a simple apparatus for measuring the relative activities of different nickel catalysts.

The Streatfeild Memorial Lecture

Chemical Industry as a Branch of Science

MR. W. P. DREAPER, F.I.C., delivered the annual Streatfeild Memorial Lecture at the Finsbury Technical College, London, on Thursday, October 20. Taking as his subject the greater need for the recognition by industry of the importance of science in general and chemical science in particular, he said he looked forward to the time when there would be a definite, if small, scientific party in the House of Commons, when science would be enabled to take a far more direct interest in the affairs of the country than was now the case. It was unfortunate that work started during the war with the object of capturing foreign trade, had since been shelved or abandoned, and we had in some directions slipped back into a somewhat unsatisfactory position. The chemist had not relaxed his efforts, but he alone could not regain and hold for British industry a position equal to that achieved by other nations after years of steady preparation. There must be some radical defect in our methods arising from want of understanding, or through sheer inability to grasp essential points. One heard of important works being shut down, and the scientific staff disbanded because prices of production had fallen abroad. There was no magic in the work of the foreigner and, rightly understood, such a condition was a sign for the need of further research. When adverse conditions revealed themselves, research work should be doubled. How could such adverse conditions be made impossible in future ? Only when the chemist took part in the organisation of industry as a whole would real progress be made. When science was fully recognised, the organisation of industry would be correspondingly satisfactory. The business man had done wonders in the past while he had been in charge of chemical industries run on empirical lines, but he must now remember his scientific partner and must cease to treat the scientific investigator as if he were a trade competitor.

Widening the Chemists' Outlook

The essential problem before industry was to strengthen the position of the chemist and to widen his outlook. This had been realised in Germany 20 years ago and had since been appreciated, although perhaps to a lesser extent, in other countries, such as America and Italy, where reasonable encouragement was given to those who engaged in research and gave their lives to the furtherance of scientific attainment. The position in Germany was well known, but it was not fully realised that America was even progressing further on the same lines. The American banks, for instance, had now chemical partners to advise them with regard to financing chemical industries and large sums of money had been, and were being, spent in purely experimental work with a view to testing the commercial possibilities of new processes. It was often found that young English chemists were in charge in American works solely for the reason that the position of the chemist was more fully recognised in America than was the case here.

The future task before the chemist was almost beyond belief. During the war, in the munitions works, there was one chemist for about every 50 workers. It was estimated that there were 400,000,000 workers requiring scientific guidance and direction. Assuming one chemist for every 5,000 workers, that would require an army of 80,000 chemists, and that number would, Mr. Dreaper asserted, increase production and improve efficiency by 20 per cent. at least. The general work of the next generation of chemists would probably not be so much concerned with research as with the spreading of the scientific spirit into industry, and its organisation on this basis. To secure this it would be necessary to advertise the claims of science in every direction.

The Penalty of Neglecting Research

Two instances of the results of failure on the part of industry to grasp the commercial possibilities of research in this country were supplied by the textile industry in connexion with the processes known as mercerising and schreinering. In both cases, after the preliminary work had been done in this country, it was left to Germany to develop commercially. A third and perhaps more interesting example was the production of synthetic ammonia from hydrogen and nitrogen, the first steps in connexion with which were taken in this country, yet the manufacture of synthetic ammonia represented a triumph for Germany and her scientific methods. The French had also been experimenting with extremely high pressures, and Claude had increased the yield of ammonia by working at about 1,000 atmospheres pressure, as against the 200 used in Germany. It was, of course, also generally well known that work had been carried out in this country during the last two years on lines similar to those adopted by Haber in Germany. Many other instances could be given of a like nature, but they all illustrated the same point, namely, that the fault lay with our industrial system.

Another instance of the difference between the technical knowledge of the German business man and that of the British business man was brought out in the case of the dye industry, which, as everyone knew, started in this country.

Coming to agriculture, Mr. Dreaper said it had recently been stated that Germany produced 63 per cent. of the world's synthetic nitrogen products, and Great Britain but 1·9 per cent. It was to be hoped, for everybody's sake, that Great Britain's output would rapidly increase until it approached the German figure. In this same connexion, namely, agriculture, the announcement had recently been made of an important discovery at Rothamsted concerning a radical improvement in fertilisers, and yet the development of it was rendered difficult through want of funds to fit up a demonstration plant to inform farmers of the results. Mr. Dreaper exhibited a sample of the new fertiliser, and stated that its moisture content was 83·80 per cent. The total nitrogen in the dry matter was 2·16 per cent., and the ash in the dry matter was 21·40 per cent. The manure was intended to be used as a source of nitrogen in a highly available form and of organic matter, and in these respects it was as valuable as ordinary farmyard manure, although deficient in phosphates and potash.

As to the amount which a chemical company should spend upon research, he suggested a sum equal to 10 per cent. of the average profits of the concern. When profits fell, this amount should still remain as a fixed charge upon the business and be written off against goodwill. Depreciation of plant was always allowed for, but in how many cases was depreciation of processes equally provided for ?

Presentations

At the conclusion of the lecture, Professor G. T. Morgan, who presided, presented the Streatfeild Memorial Medal, and also a portrait of Streatfeild, to Mr. Dreaper. In addition, a prize of £5, from the memorial fund, for work on practical chemistry to a Finsbury student was awarded to Mr. D. A. Smith, Diploma Student in the Department of Applied Chemistry.

The interesting announcement was made by Professor Morgan that Finsbury will not be shut down, as was threatened last year, and in consequence, the Meldola Memorial Library, the completion of which has been held in abeyance during the war, will shortly be completed at Finsbury, and made available to the students.

Work of the Metallurgical Chemist

IN the course of an address before the Sheffield Association of Metallurgists and Metallurgical Chemists on Monday on "The Work and Position of the Metallurgical Chemist," by Sir Robert Hadfield, and read, in his absence through illness, by Mr. S. A. Main, the author stated that we in this country have had so many brilliant chemists that he had never been able to understand why Teutonic chemists have been held up to such glory, though it must be admitted that in the past they had played a useful part in chemical science. He declared that he, personally, had never felt any alarm about their competition, whether mental or physical, and although it was true that their industry and application covered a multitude of their other sins, he saw no reason to think they were superior men. The address was illustrated with cinematograph films and lantern slides. Owing to the large demand for copies of the address, Charles Griffin & Co., Ltd., of 12, Exeter Street, Strand, W.C., have decided to publish it together with a number of interesting illustrations. The book will be handsomely bound in cloth, and will be sold at 10s. 6d.

The Institution of Rubber Industry

Inaugural Meeting in London

As briefly announced in THE CHEMICAL AGE last week, the inaugural meeting of the Institution of Rubber Industry was held on Wednesday, October 19, at the Royal Society of Arts, London, Mr. J. H. C. Brooking, M.I.E.E., the President of the Institution, in the chair.

In the course of his address, Mr. Brooking, referring to the need for this Institution, said the experience of other large industries which had institutions for increasing their technical knowledge and overcoming difficulties, showed that they had profited by the papers read before them, and by the discussions on points of general interest.

Origin of the Institution

Explaining the origin of the Institution and its alteration of name, Mr. Brooking said that in 1919 Mr. Fordyce Jones advocated the establishment of a Rubber Club or other central authority, embracing the whole of the rubber industry. Later, Mr. Herbert Standring convened meetings of people interested in rubber manufacture, with the idea that an organisation on the lines of the Rubber Club of America would be of value to British rubber manufacturers and traders. This resulted in the formation of the Rubber Club of Great Britain. Later it was decided that the title of "Club" was a misnomer, and that it would be best for the more or less serious work expected from the organisation to be carried out under the title by which it is now known.

The Institution was starting at a period of almost unparalleled depression in industry, and particularly in the rubber growing industry, and it was uncertain what was going to happen. It was all the more necessary, therefore, that those interested in similar matters should get together for mutual help.

After a brief description of the progress made since the earliest days of rubber manufacture, Mr. Brooking said the rubber industry dealt with basic materials that were often unstable in themselves, and exceedingly prone to variability in their manufactured results. The ingredients of manufactured rubber were not only variable, but the large number of these ingredients, the difference of opinions regarding the use of them, and the proper proportions of each of them to use in different mixings for different manufactures, the degree and period of vulcanising heat to apply, and other problems, resulted in a combination of uncertainties that were often dealt with by judicious guesswork or by rule-of-thumb, or by hit-and-miss experiment.

There was possibly no other manufactured material that was so liable to trouble from slight and almost imperceptible manufacturing variations that were meant to cheapen cost, without perhaps intending to lower quality, in order to compete with other manufacturers' cut prices. If only prices could be kept stable at a reasonable profit then competition could be based on the quality of the manufactured article, which was the best kind of competition after all.

Mr. Brooking referred to the value of consulting expert rubber chemists. This, he said, applied more particularly to those manufacturers who did not possess the large technical staffs employed by the larger companies.

The Institution of Rubber Industry should be of value in bringing together the three principal factors in rubber industry—the growers, the manufacturers and the distributors—to discuss matters of mutual interest to their mutual advantage.

Sir Henry Wickham's Adventures

Mr. Brooking then read extracts from Sir Henry Wickham's account of his experiences in securing the seeds from Brazil in 1876, which originated the rubber plantation industry in the East. Sir Henry then gave further particulars and described the advantages of the hard cure process.

Rubber Manufacture

Mr. H. Rogers, in a paper on "Rubber Manufacture," gave an historical review of the industry from its earliest days up to the present time. The fact, he said, that specimens of rubber smoked by the natives hundreds of years ago still existed and retained many of their characteristics was indeed remarkable, and in the unvulcanised condition it was quite certain that smoked latex as prepared by the natives had greater keeping properties and retained its strength much longer than any unvulcanised rubber purified and prepared in our factories by the best modern methods. The wonderful keeping qualities of raw Para rubber suggested that there were undiscovered possibilities in the use of latex as a raw material rather than coagulated rubber. The effect of mastication and solvents on coagulated rubber, while enabling the material to be worked more easily, at the same time tended to destroy the structure of the material, while if the latex were used, no masticating or dissolving would be necessary, and vulcanisation by such processes as the recent discovery of Peachey might make possible new industries capable of absorbing all the latex. Many attempts had been made to use latex as a raw material, but the lecturer said he had not heard of any successful application.

Early English Patents

Rubber goods made by the natives of America were known in Europe as long ago as 1759. One of the earliest English records, said Mr. Rogers, appeared in a patent taken out in 1791 by Samuel Peal for a waterproofing solution made by dissolving rubber in spirits of turpentine or other spirits or oils over a brisk fire. In 1813 John Clark took out a patent for a process of utilising rubber for cushions, and in 1820 Thomas Hancock patented a process for the use of rubber in clothes, boots, &c. From 1820 to 1843, except for Hancock's discovery of a means of masticating rubber, the whole industry was confined to the use of unvulcanised rubber. Charles Goodyear, of America, was the first to produce a compound containing rubber, and having properties which enabled it to withstand changes in temperature without becoming soft and sticky, but he apparently failed to make practical use of his process until after Hancock had made his famous sulphur-bath discovery which he patented in 1843.

By immersing strips of rubber in molten sulphur, Hancock discovered that the rubber absorbed the sulphur and that, according to the temperature and time immersed, it was possible to obtain both soft vulcanised rubber and also the hard vulcanised rubber known as ebonite.

From 1843 onwards many processes for the treatment of rubber were evolved and endeavours were made to produce vulcanisation by other means, but with the exception of the patent of Alexander Parkes in 1846, for producing the change in rubber by the action of mixtures of chloride of sulphur with bisulphuret of carbon, all other processes proved unsuccessful.

Little was known then of the actual chemical reactions taking place between rubber, sulphur and many other ingredients. Thomas Bolus, lecturing in 1880 before the Society of Arts, while describing the methods of manufacture and the machinery used, was very uncertain of the actual chemical reactions taking place in either hot or cold vulcanised rubbers, and for many years afterwards the actual analysis of rubber compounds was hardly possible.

Synthetic Rubber

With the raw product at its present price Mr. Rogers said that "synthetic rubber" seemed now less likely to interest the fortune-hunter, but the research work undertaken in this connexion had indirectly led to the discovery of organic accelerators of vulcanisation which were not yet fully appreciated or understood.

The Northern Polytechnic

The Northern Polytechnic in London had already realised the need for the special training of young men entering the rubber industry and had started with a well-equipped model rubber plant under the direction of Dr. Philip Schidrowitz. It might prove difficult for London to provide trained men to satisfy the whole of the industry, but it was undoubtedly a start in the right direction.

An interesting discussion followed in which Dr. H. P. Stevens and Messrs. Sellers, Koens, H. Standring, Spencer Smith, Longworthy, Palmer, Howie, and Taylor took part.

At the Imperial Fruit Show at the Crystal Palace on Friday, November 4, Mr. P. J. FRYER, technical director of the Yalding Laboratories, Maidstone (familiar to our readers as a contributor to THE CHEMICAL AGE), will speak on the question "How to produce clean fruit."

The Dyeing of Acetyl Silk

Problems Created by the New Production

MR. J. F. BRIGGS, of the British Cellulose & Chemical Manufacturing Co., gave a lecture on "The Dyeing of Acetyl Silk" before the West Riding Section of the Society of Dyers & Colourists at Bradford on Thursday, October 20. Mr. H. Jennings presided. By courtesy of the British Dyestuffs Corporation, many beautiful specimens of the new silk were exhibited, dyed with various ranges of colours.

History of Artificial Silk

Mr. Briggs said that the history of artificial silk dated from the eighties of last century, when Chardonnet introduced a fibre of collodion extruded from glass spinnerets. This silk, in the form of an ester of cellulose, possessed many remarkable properties, but was violently inflammable. It consequently gave way to a cellulose silk. Subsequently viscose silk—which was also a hydrated cellulose fibre—came on the market and now took the premier place in volume of production. As these silks emerged into the more open competitive markets, the demand for quality became more stringent. There were one or two failings in the artificial fibres of hydrated cellulose, notably their relative lack of resistance to rough treatment in the wet condition, and an absence of liveliness and fullness in the hang and handle of the finished goods. During the last decade attention had been turned to the production of an ester silk of low hydration which should be free from the inflammable properties of collodion silk whilst possessing its most desirable attractions. Acetyl silk, the new ester-silk, was the direct outcome of the cellulose acetate industry, which came into existence for war purposes. The new silk was now entering the market as a commercial product. Given the new product, the dyer had to consider the chemical and physical properties of the fibre-substance itself, particularly in the points where they differed from the affinities of the hydrated cellulose silks with which he was already familiar.

The animal fibres, silk and wool, were chemically defined as animo-carboxyl colloid bodies of predominant basic functions; in other words, they exerted their principal activities in their relations to acids. The cellulose fibres, such as cotton and its derived modifications, had been described by competent authorities as hydroxylated colloid, of approximately neutral functions. Their affinities were determined by hydroxyl groups with acidic and basic functions fairly evenly balanced, though with a slight inclination towards the acid side. The introduction of acetyl groups into the cellulose molecule had two effects: the suppression of most of the hydroxyl groups so that the product was no longer mainly an hydroxylated colloid, and a redistribution of the balance between acidic and basic functions so that the acidic definitely predominated. The control of these two chemical factors defined the problem presented to the dyer in dealing with cellulose acetate silk.

Resistance to Water

Owing to the residual hydroxyl groups which were present in small proportions, cellulose acetate silk was not absolutely indifferent or impervious to water, but the amount of water absorbed was far smaller than with other artificial fibres, and it was this relative resistance in the presence of water which gave to acetyl silk its remarkable property of withstanding frequent and severe laundry operations. This quality of insensibility was a most valuable asset, imparting far-reaching advantages to the fabric when used as wearing apparel or under-garments. The silk, for instance, was a non-conductor, not only of electricity but also of heat, and the problem of warmth versus weight was thus solved. Perspiration did not wet it, and evaporation from wet outer-garments did not chill the body.

With few exceptions the affinity shown for the group of substantive cotton dyestuffs by the untreated acetyl silk was only slight. Nevertheless, all these dyestuffs could be utilised by a simple chemical treatment, either before or during dyeing. This treatment consisted of a partial restoration of the hydroxyl groups by a limited saponification with caustic or other alkali. On the other hand, most interesting and valuable results were obtained by taking advantage of the chemical constitution of the silk as an ester, and selecting classes of dyestuffs containing constituent groups which were in sympathy with the ester and which dyed it without any chemical modification whatever. Towards aromatic bases and basic dyestuffs the ester-silk presented a definite and very pronounced absorption and fixation capacity, which appeared to be attributable to the entrance of acetic acid into the cellulose molecule, and the consequent shifting of the balance of affinities towards the acid side.

Practical Methods of Dyeing

Practical methods of dyeing acetyl silk might, therefore, be classified broadly under two distinct headings:—(1) The saponification method, in which the constitution of the silk was chemically modified from the surface inwards, in such a manner as to regenerate a portion of the cellulose, which could then be dyed by the same methods and with the same dyestuffs as the older artificial silks; (2) the direct method, in which advantage was taken of the properties of the silk as a cellulose ester, and dyeing was carried out with selected dyestuffs without any modification of its chemical composition. By means of the first method, any of the basic, substantive, sulphur, and vat dyestuffs could easily be dyed to full shades. With regard to the direct method, it was necessary to correct the impression that acetyl silk could not be dyed except by the use of swelling agents. On the contrary, silk could be dyed without any modification or pre-treatment to any desired shade and degree of fastness just as easily and as cheaply as any of the older artificial silks, but, of course, just as wool and cotton had their particularly suitable classes of dyestuffs, so acetyl silk showed special differences in affinities.

Mr. Briggs discussed in detail the method of application of the various dyestuffs. With regard to the azoic process, he said the remarkable affinity of cellulose acetate for aromatic amines and phenols suggested a vast range of possibilities for developing azo dyestuffs by diazotising on the fibre. There seemed no limit to the possible combinations obtainable. He thought he had said sufficient to show that the dyeing of acetyl silk was not more difficult than the dyeing of any other artificial fibre, only it was somewhat different. The dyer had to get used to it. The azoic method offered attractive possibilities of future extension and gave dyeings of unexampled solidity and brilliancy. As the demand developed, dyestuff makers would bring forward new dyes specially designed for this silk. The silk itself both in handle and appearance was, he claimed, superior to anything which had gone before. Difficulties in manufacture, in application, and in dyeing had been encountered and overcome, and the new industry was both technically and commercially established.

Discussion

Mr. D. McClellan asked if Mr. Briggs had done any work on the dyeing of mixed piece goods of silk and cotton or silk and wool.

Mr. Briggs said they had succeeded in doing so, chiefly by the saponification process. He did not recommend the saponification process, however, if the direct method could be used, and the direct method of dyeing mixed fabrics was still under investigation, and he could not give any definite results. By the saponification method it was quite easy.

Mr. W. Harrison said the azoic colours did not lend themselves to mixed shades, and he thought development would be along the lines of evolving a range of dyestuffs which would be direct in relation to acetyl silk in the same manner as certain colours were direct cotton or direct wool colours.

Mr. Bearder asked why Mr. Briggs thought the saponification process would become almost obsolete?

Mr. Briggs replied that there were a number of small reasons which made a big reason in the aggregate. There was the question of handling and the effects of moisture. The direct method was simpler and more native to the qualities of the silk.

We understand from CAPTAIN C. J. GOODWIN, head of the London office of Oscar Guttmann & Sons, consulting chemical engineers, that he has moved from 60, Mark Lane, E.C.3, into new offices at 7 and 8, Idol Lane, Eastcheap, E.C.3, his new telephone number being Minories 1907. The business was established in Mark Lane in 1887, and there is an American branch office at Kingston, Ontario, Canada. Captain Goodwin has just returned from an extended trip in Canada and the United States.

Society of Glass Technology

Opening Meeting of the Session at Sheffield

THE opening meeting of the Session 1921-22 was held in the Applied Science Department, the University, Sheffield, on Wednesday, October 19, the president (Dr. M. W. Travers) in the chair. Prior to the meeting, members had an opportunity of lunching together, when the President made some observations on the work of the new Session.

Comparative Compositions of Pot Clays

The first paper read at the meeting was by Mr. G. V. Evers on "The Comparative Compositions of Pot Clays from the Stourbridge District during the last 50 years." It was found that the clay of the present day showed a decrease in the percentage of silica content, and a corresponding increase in the alumina content. Its refractoriness was in no way inferior to that of clays obtainable 30 and 50 years ago. Therefore, the complaint of glass manufacturers and other users of refractory materials that the refractories of to-day were inferior to those of yesterday could hardly be substantiated. In the lecturer's opinion the greatest failure in pots of the present time was due, not to the inferior quality of the refractory materials, but rather to the higher temperatures used, and the increased production, involving increased duty on the pot. If the refractory manufacturer was to make improvement in the quality of his material he needed the active co-operation of the users of his material, and Mr. Evers made a plea for systematic information from the users of refractory materials, which would enable the producers to modify or improve their refractories to suit particular requirements.

There took part in the discussion that followed the President, Mr. W. J. Rees, Dr. C. J. Peddle, Mr. E. A. Coad-Pryor, and Professor W. E. S. Turner. Mr. Evers replied.

Properties of Lime-Magnesia Glasses

The second paper submitted was on "The properties of the lime-magnesia (dolomite lime) glasses and their commercial application," by Violet Dimbleby, B.Sc., S. English, M.Sc., F. W. Hodkin, B.Sc., and Professor W. E. S. Turner. This paper was read by Professor Turner and illustrated by lantern slides.

Professor Turner said that the introduction of small amounts of magnesia together with lime resulted in the production of a more fluid glass which was much more easily melted than the corresponding magnesia or lime glasses. The lowering of the annealing temperature due to the use of both the ingredients, and the reduction as compared with the lime-containing glass of the thermal expansion, rendered annealing easier and would reduce the amount of fuel required for the lehrs. The production of such glasses depended on a supply of a suitable form of magnesia or dolomitic limestone. Up to the present no source of such material was known where the iron content was sufficiently low to permit the manufacture of colourless glass from it and an appeal was made for any possible information as to a likely source for obtaining such material with an iron content of something like 0·1 per cent.

In the discussion, Mr. W. J. Rees mentioned that he had examined the majority of magnesites and magnesian limestones obtainable in this country and elsewhere, and was unable to suggest a suitable source. The Greek magnesites were exceptionally pure, but their utilisation in the glass industry was almost certainly prohibited by the cost as compared with the British limestones.

There also took part in the discussion the President, Messrs. V. H. Stott, and E. A. Coad-Pryor, Professor W. E. S. Turner and Mr. F. W. Hodkin replied.

The President intimated that the next meeting would be held in Leeds on November 16. This meeting would resolve itself into a discussion of questions sent in by members on matters relating to the melting of glass.

Key Industries Arbitrator

THE Lord Chancellor has appointed Mr. Cyril Atkinson, K.C., to be the REFEREE TO DECIDE COMPLAINTS referred to him by the Board of Trade under Section 1 (5) of the Safeguarding of Industries Act, 1921.

The Restoration of British Industry

Engineers' Fifteen Points

THE British Engineers' Association have adopted and circulated the following fifteen points as essential conditions of a national effort to restore prosperity to the industry :—

1. The loyal co-operation of labour in a great national effort to revitalise our industries and commerce, which are the only possible sources of its own well-being.
2. The repudiation by the trade unions of the declared policy of their extremist sections to render the system of capitalism and private enterprise unworkable.
3. The institution of compulsory secret ballot by the trade unions.
4. The reduction of cost of production by amending the conditions affecting the output per £ of wages paid.
5. The careful consideration of a national trade policy more in consonance with the new conditions with respect to foreign competition in our home market, and the raising of tariff walls abroad tending to shut out our exports.
6. The development of the home market and the confinement to this country of contracts involving the expenditure of public moneys.
7. The development of markets within the Empire.
8. National economy.
9. Reduced taxation of wealth-productive industries.
10. Unemployment relief work to be of a productive nature to the greatest extent practicable.
11. The payment of doles uncompensated by work done to be reduced to the minimum.
12. Cheaper coal, valued in terms of heat units.
13. Due consideration to be paid by the Government to the possible effects upon industry of a policy of deflation.
14. The taking of drastic measures to reduce the cost of living in so far as it may be due to profiteering by the few at the expense of the many.
15. A more complete and better organisation of industry for its good government from within.

Indian Institute of Science

Sir William Pope Chairman of Inquiry Committee

THE India Office announces that in consequence of representations from the Standing Committee of the Court of Visitors of the Institute of Science at Bangalore, India, the Viceroy has appointed a committee of inquiry to examine the working of the Institute with a view to making suggestions as to its future policy. The object of the Institute, as originally projected by the late Mr. J. N. Tata, was to encourage research in pure chemical and physical science, but it has, in the course of a comparatively short career, developed a distinct tendency towards the study of problems which are likely to lead to results of immediate economic value. Sir William Pope is to be chairman of the committee, and Sir Arthur Shipley and Sir Henry Hayden are the members appointed from this country. The rest of the committee will be appointed in India.

Chemical Showcards for the East

H.M. TRADE COMMISSIONER at Singapore reports to the Department of Overseas Trade that his attention has frequently been drawn by local chemists and druggists to the failure of United Kingdom firms to supply effective advertising matter for shop-window and counter display. He points out that this method of advertising is far more effective in the East than newspaper advertisements and that chemists find that the prominent display of effective showcards, together with a good window display, has a very appreciable effect on sales. Comparatively speaking, only a very small percentage of the native population read the local papers. The supply of dummies, to permit of a good window display, and cardboard stands is also important, as owing to the heat and sunlight articles deteriorate with extreme rapidity if shown in the shop window.

The ATMOSPHERIC NITROGEN CORPORATION, a United States organisation, started operations during September with a new plant at Syracuse, New York, where a modification of the Haber process has been adopted. The capacity of the plant is one-thirteenth of that at Oppau.

Chemical Matters in Parliament

Safeguarding of Industries Act

IN reply to Mr. Mosley (House of Commons, October 20), Mr. Young said the amount of duty collected from October 1 to October 18, inclusive, under Part I. of the Safeguarding of Industries Act, was £7,009. No Order had been made under Part II. of the Act, and therefore no duty had become chargeable.

Replying to another question by Mr. Mosley, Mr. Young said duties had been levied under the Act upon goods imported from France.

Customs Arrangements

Lieut.-Commander Kenworthy (House of Commons, October 20) asked the Financial Secretary to the Treasury whether he was aware of the growing congestion at Folkestone, Hull, and other ports due to the collection of duties under the Safeguarding of Industries Bill and the German Reparation Act, which, despite the overtime which the Customs officials were working and the increase of staff, was insufficient to cope with the traffic; and what action he proposed to take with a view to simplifying the procedure so as to effect a more speedy clearance and thus avoid the delays and heavy expenses for rent?

Mr. Young said he was informed that the Customs staff at the various ports was dealing with the work as it reached them and any delay was not attributable to the Customs arrangements. In order to facilitate clearance in cases where the necessary evidence of value was not forthcoming, the Customs were prepared, as a temporary measure, to allow delivery on an adequate deposit being made to cover the estimated liability.

Naval Bleaching Factory

Mr. Waddington (House of Commons, October 20) asked the Parliamentary Secretary of the Admiralty whether the proposal to erect a cotton bleaching factory at Holton Heath, Dorset, had been withdrawn for the current financial year; and would he, in any subsequent consideration of the scheme, be prepared to hear technical evidence before the work was again authorised?

Commander Eyres-Monsell said the proposal had not been withdrawn, but certain technical considerations were still being carefully scrutinised, and until the Admiralty were absolutely satisfied, no further work would be proceeded with at Holton Heath. Technical knowledge and evidence were the bases of this proposal and the Admiralty had employed and were employing eminent chemists to advise them.

Cornish Mining Industry

In reply to Sir E. Nicholl, who asked if any scheme had been formulated for the employment of the Cornish miners who were destitute through the closing down of the mines, Mr. Bridgeman (House of Commons, October 20) said the matter was receiving careful attention in connexion with the Government's general proposals for the relief of unemployment.

Sodium Salts

Mr. Newbould (House of Commons, October 24) asked the President of the Board of Trade whether he was aware that six small samples of sodium salts, sent on October 5 from Paris to a firm in London for test purposes, was being detained by the Customs authorities; that, on October 11, the Customs authorities advised the consignee that the samples were being detained in order that entry should be made, value declared, and duty paid; that the consignee replied on the same day that the samples together weighed less than 1 lb., were of no commercial value, and were not dutiable; and that he wrote again on October 18 complaining that the samples were still detained?

Mr. Young said he would personally inquire into the matter.

Inspection of German Chemical Works

Mr. W. J. U. Woolcock (House of Commons, October 26) asked the Secretary of State for War whether he had seen a book entitled "The Riddle of the Rhine," by Major V. Lefebure; whether he was aware of the great strength and menace of the German organic chemical industry; and what measures had been taken under the Peace Treaty to deal with poison gas factories.

Sir L. Worthington-Evans, in a written reply, said the military authorities were well acquainted with the book named, and with the potential military value of the chemical industry of Germany. No commercial ruling had been superimposed on Articles 168 and 169 of the Treaty of Versailles, and the Inter-Allied Commission of Control was engaged in securing, by the inspection of over 7,000 chemical factories, the observance of the conditions of those Articles, including the destruction or conversion of all plant specifically adapted for the manufacture of poison gas.

Canadian Scientific Apparatus Exhibition

United Kingdom Firms to Participate

IN connexion with the annual meeting of the American Association for the Advancement of Science to be held in Toronto from December 27 to 31, it is proposed to hold an exhibition of scientific apparatus and products and recent scientific works in a building at the University of Toronto.

H.M. Trade Commissioner at Toronto reports that he has been requested by the committee of the Association to secure the participation of an adeqate number of United Kingdom manufacturers. It is believed that large numbers of United States manufacturers will make exhibits. The committee do not desire, and will not accept for display, familiar types of scientific apparatus, &c. Exhibits will be limited to apparatus or products of a highly improved or exceptional type, and of definite interest and appeal to those interested in scientific research, the scientific staff of universities, those employed in Government and industrial laboratories, &c.

It is important that any United Kingdom manufacturer intending to participate should bear in mind the stipulation as to the nature of the exhibit, otherwise expense of shipping may be incurred in connexion with apparatus, &c., which the local committee will not ultimately sanction for display. It is understood that there will be no charge for space, and that arrangements are being made whereby United Kingdom firms without local agents may secure, at comparatively small expense, the services of a responsible person who will carry out the necessary local arrangements.

All communications of United Kingdom manufacturers in regard to the above should be addressed to Mr. Westman, Secretary, Committee-in-Charge of Exhibits (A.A.A.S.), 57, Queen Street, West Toronto, and it is advisable that action should be taken at once by firms proposing to make exhibits. The Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1, is prepared to supply such further information as it has available on application by interested United Kingdom manufacturers.

German Dye Production

ACCORDING to our New York contemporary, *Drug and Chemical Markets*, recent statistics on German dyestuff production indicate that it has fallen off since 1920 and is now about 25 per cent. of the pre-war amount. During 1920 it fell as low as 18 per cent., but recovered in the latter part of the year to 32 per cent. During February of this year the production was 3,585 tons, in March 3,960 tons, in April 3,800 and in May 4,008 tons, an average for the period of approximately 3,800 tons per month. The amounts of the more important dyes and classes of dyes produced in this four months period were as follows: Alizarine red, 524 tons; indigo, 3,744 tons; vat dyes, exclusive of indigo blue, 581 tons; indanthrene blue GCD, 18·4 tons; direct cotton colours, 2,912 tons; acid colours, 2,848 tons; chrome colours, 829 tons; basic colours, 1,100 tons; lake colours, 612 tons. One quarter of this production is reserved for the Allies under the terms of the Peace Treaty.

Chemical Manufacturer's Fortune

MR. WILLIAM JAMES CHRYSTAL, of West George Street, Glasgow, of John & James White, Ltd., who died on April 21 last, left in addition to real estate, personal estate of the total value of £1,145,160. Other millionaire chemical manufacturers of recent years were the late Sir Charles Tennant, who left £3,151,976, and Dr. Ludwig Mond, whose estate was provisionally valued at the round figure of £1,000,000.

From Week to Week

It is reported that NOBEL INDUSTRIES, LTD., intend to establish a new factory at Heath, near Chesterfield.

Considerable damage was caused on Monday by an EXPLOSION IN A CHEMICAL FACTORY at St. Ouen L'Aumone, near Paris.

Dr. T. S. HELE and Dr. R. A. PETERS have been appointed additional lecturers in biochemistry in the University of Cambridge.

The Senate of London University are inviting applications for the UNIVERSITY CHAIR OF CHEMISTRY, tenable at St. Thomas's Hospital Medical School.

In a written reply to Major Barnes, Mr. Hilton Young stated that the receipts under the GERMAN REPARATION (RECOVERY) ACT up to and including October 22 amounted to £1,330,677.

At a meeting on Wednesday of the Newcastle-on-Tyne Section of the Society of Chemical Industry, DR. GEOFFREY WEYMAN read a paper on "The Rate of Carbonisation of Coal."

In the University of London the DEGREE OF D.SC. (Chemistry) has been conferred on Mr. C. K. Ingold, internal student, Royal College of Science, and Mr. H. Hepworth, external student.

The inventors of what is described as "a very VALUABLE ALLOY which will revolutionise the chemical, steel and electrical industries" announce that they are desirous of meeting a few gentlemen to form a company.

The British Lampblown Scientific Glassware Manufacturers' Association, Ltd., has sent a circular to Members of Parliament calling attention to the situation created by the postponement of the Clinical Thermometer Bill.

At a meeting of the Railway Rates Advisory Committee on Tuesday, to consider proposals in regard to a new classification for coal, coke and patent fuel, the Committee declined to make an order for reduced charges as suggested by traders.

What is described as the FIRST BATCH OF DYES ever manufactured in Canada was turned out by Canadian Dyes, Ltd., Trenton, Ontario, on September 19, when about 1,700 lb. of Canadian Direct Blue 2B. was successfully finished in the first process of making.

Mr. S. ELLINGWORTH, M.Sc., Leeds, has been appointed Research Assistant in Organic Chemistry in Leeds University. Recent grants received by the University include an additional donation of £1,000 to the textile industry and dyeing departments of the University.

At the first meeting on Friday, October 21, of the 1921-22 Session of the Manchester Section of the Society of Dyers and Colourists (Professor E. Knecht presiding), a paper was presented by Mr. Horace Lowe, F.I.C., on "The Inter-relation of Mercerisation and Spinning."

An increase in the number of MEN EMPLOYED IN THE CHEMICAL INDUSTRY in the United States was shown for the month of September, according to the figures of the U.S. Employment Service. The increase on September 30 as compared with August 31 was 2·6 per cent.

Sir GARROD THOMAS has intimated to the Governors of the University College of Wales, Aberystwyth, his intention to give to the college farms of the value of about £8,000 at Llanarth, Cardiganshire, the income to be devoted to the encouragement of post-graduate work in chemistry and physics.

In connexion with certain rumours regarding a proposed amalgamation between the British Cellulose & Chemical Manufacturing Co., Ltd., and another undertaking a representative of THE CHEMICAL AGE was informed by an official of the Company that the rumours are without any foundation, and that no fusion of any kind is in contemplation.

A correspondent of the *Financial News* states that the administration of the sequestrated German potash mines in Alsace have published a balance-sheet as at May 31, 1921. According to this, the profit of sequestrated companies during the first five months of this year amounted to 16,696,332f., against 127,478,979f. for the period 1919-1920.

In order to facilitate the procedure of obtaining LICENCES FOR THE IMPORTATION OF DYESTUFFS the Council of the Colour Users' Association discussed with the Dyestuffs Advisory Licensing Committee the difficulties which have arisen during the past few months. In this connexion the Association have issued a circular suggesting methods to be adopted by users.

In the Divorce Court on Tuesday before Sir Henry Duke, the hearing was begun of a petition for the dissolution of his marriage, by Mr. C. W. Hodsdon, research chemist, of Kensington Gardens Square, and formerly in the employ of British Dyes, Ltd., of Huddersfield. The petitioner was granted a decree and also the custody of the child of the marriage. His counsel intimated that £1 a week alimony would be paid to Mrs. Hodsdon.

Speaking at a meeting of the Yorkshire & North Eastern Section of the INSTITUTE OF BREWING on October 20, Mr. H. E. Field, president of the Institute, made special reference to the far-reaching scientific investigations now being undertaken by the Institute. Chemical investigations had been proceeding in the College of Technology, Manchester, for some time past to endeavour to isolate and determine the constituents of the hop.

The Engineering Group of the Society of Chemical Industry will hold a meeting at the Manchester School of Technology on Friday, November 4, when a paper on "Electrical Precipitation" will be read by Dr. H. J. Bush. The Group will also hold a meeting on November 22 at the Institution of Electrical Engineers, London, when Mr. J. H. West will read a paper on "The Claude Synthetic Ammonia Process and Plant."

On October 19 the Junior Branch of the West Riding Section of the Society of Dyers and Colourists paid a visit to the works of Messrs. Hickson & Partners, Ltd., at Castleford, and were shown round by members of the staff. Considerable interest was evinced in the new plant for the production of Vidal Victory Black in liquid form. This is turned out by the latest patented processes of Mons. R. Vidal, who produced and patented the first Sulphur Black in 1893.

Tenders Invited for Calcium Carbide

THE Administration of the Chilean State Railways invites tenders by December 6 for the supply of calcium carbide and burning and lubricating oils, &c. The representative of the Chilean State Railways in Paris, whose address is 88, Boulevard St. Michel, has been instructed to obtain prices in the United Kingdom and remit same by cable on the day previous to the opening of the tenders. A copy of the specification (in Spanish) can be inspected by United Kingdom firms interested on application at the Department of Overseas Trade (Room 84), 35, Old Queen Street, until November 3, after which date it will be available for firms in the provinces unable to arrange for its inspection in London.

Handy Desk Companions

WE have received from Meldrums, Ltd., manufacturers of chemical plant, of Timperley, Manchester, a neat little loose leaf pocket-book and a desk blotter. They also send a list showing the wide variety of industries in which their forced-draught furnace fitments have recently been installed.

The Victory Pipe Joint Co., Ltd., manufacturers of the Hele-Shaw and Tribe system patent "Victaulic" leak-proof pipe joints, of 28, Victoria Street, S.W.1, send us a neat and useful 4 in. steel pocket rule, marked in metres and inches. A figure showing the Victaulic joint in position is shown on the reverse side.

Recent Wills

Mr. W. J. Chrystal, of West George Street, Glasgow, and of Auchendennan, Arden, Dumbartonshire, chemical manufacturer, of Messrs. John and James White, Ltd. £1,139,139

Mr. H. C. Heathcote, of Mooresfold, Winster, Derby, chemist and druggist £12,711

Mr. J. Green, of Sherburn Tower, Rowlands Gill, Durham, at one time a partner in Messrs. Green & Son, wine and spirit merchants, and oil refiners, Gateshead £13,013

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ANALYSIS. Rapid estimation of copper or iron in aluminium-copper or aluminium-iron alloys. P. Hulot. *Bull. Soc. Chim.*, September 20, 1921, pp. 836-837.

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Patent Literature

Abstracts of Complete Specifications

169,192. ROCK SALT BRINE OR SOLUTIONS OF ROCK SALT IN WATER, REMOVAL OF CALCIUM AND MAGNESIUM FROM. F. A. Freeth, Heyesmere, Sandiway, Cheshire, and L. A. Munro, Winnington Hall, Northwich, Cheshire. Application date, April 16, 1920.

The process is for purifying brine from calcium and magnesium salts by the addition of the equivalent quantities of sodium carbonate and calcium hydrate, and the object is to avoid the production of a colloidal precipitate of magnesium hydrate and calcium carbonate, which only settles very slowly. It is now found that only the smallest excess of lime should be used—*i.e.*, not more than 1 per cent., instead of the much larger excess as usually employed. The effect of a larger excess of lime is to produce a precipitate which is more finely divided. The mixture should also be agitated to a limited extent, but not sufficiently to produce a disintegration of the precipitate. It is also found that a raised temperature diminishes the time of settling of the precipitate, but increases the tendency to disintegration during stirring. The most suitable combination of these factors depends on the constitution of the brine, and is obtanied by trial. In an example, brine containing 0·055 gramme MgO and 0·252 gramme CaO per 100 cubic centimetres is treated with 0·63 gramme Na_2CO_3 and 0·102 gramme $Ca(OH)_2$ per 100 cubic centimetres of brine, and the mixture is maintained at about 14°C. The process may be carried out either intermittently or continuously.

169,198. ISOBORNYL-ESTER-CAMPHENE MIXTURE AND PROCESS OF MAKING SAME. L. G. Wesson, Chevy Chase, Maryland, U.S.A. Application date, May 17, 1920.

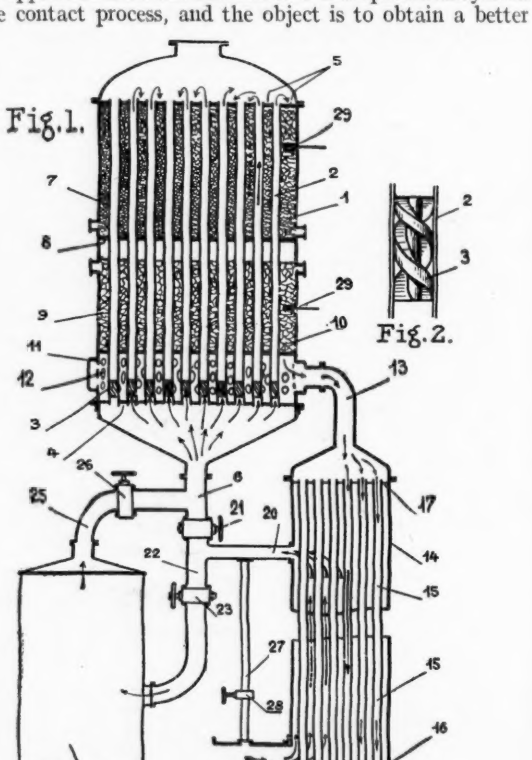
The process is for producing a mixture of isobornyl esters and camphene by heating a mixture of a hydrohaloid of pinene (*e.g.*, the hydrochloride) and an organic acid in the presence of a free metal and a zinc salt. The process is an improvement on that in which nickel powder is used, since the latter is appreciably dissolved during the reaction. Pinene hydrochloride is mixed with 2 parts of glacial acetic acid, and about 0·05 parts of silver turnings. Alternatively, the reaction may be effected in a silver-lined vessel. Metals other than silver may be used, which are electro-negative to hydrogen, such as copper, arsenic, bismuth, antimony, mercury, palladium or gold. The mixture is heated to boiling with a reflux condenser, and about 0·01 to 0·05 parts zinc chloride or metallic zinc are added. The boiling is continued for 6–18 hours or until the reaction is completed. Alternatively, the mixture may be heated by an oil-bath to a constant temperature slightly below its boiling point. It is found that when the zinc chloride is added only after the liquid has been heated the production of resinous condensation products is kept down to a minimum. Hydrochloric-acid gas is given off in the reaction, and may be absorbed in spirits of turpentine to produce pinene hydrochloride for use in the process. The silver is not materially affected in the reaction. The mixture is then treated with concentrated sulphuric acid equal to about 5 per cent. of the pinene hydrochloride, and digested for 3 hours at 50°C.–60°C., which converts the camphene present into isobornyl acetate. Sodium acetate is then added to react with the sulphuric acid, and the acetic acid formed is distilled off. In the main reaction between pinene hydrochloride and glacial acetic acid, a mixture of isobornyl acetate, isobornyl chloride and camphene is produced, and under the above conditions the proportion of isobornyl acetate may be 70–85 per cent. with not more than 5 per cent. of polymerisation products. The acetate acid may be replaced by other fatty acids, such as formic, propionic, or stearic, and also benzoic acid. The final product after the removal of acetic acid is particularly suitable for the preparation of camphor on account of its high content of isobornyl and camphene compounds, and its low content of resinous polymerisation products.

169,247. NICKEL AND NICKEL SALTS, MANUFACTURE OF. E. E. Naef, 16, Loughborough Road, West Bridgford, Nottingham. Application date, June 19, 1920.

Finely divided nickel sulphide obtained by chemical precipitation, or very finely ground nickel sulphide from nickel ore, is mixed with solid caustic soda, with or without sodium carbonate, chloride, sulphate, sulphide, calcium oxide or hydroxide, and heated in an iron, copper or nickel vessel to 300°C.–600°C. for about 15–30 minutes. Steam is given off, and the final product consists of sodium sulphide, sodium thiosulphate and finely divided nickel. The reaction may be carried out in the presence of finely divided coal and/or hydrogen, the removal of the sulphur being facilitated by these additions. The product is treated with water to remove the soluble salts and the nickel is obtained as a fine grey powder. The metal may be purified by casting it into anodes with or without a small quantity of finely divided carbon and then obtaining the nickel electrolytically. Alternatively, the nickel powder may be heated in air to produce nickel oxide, which is then dissolved in hot dilute sulphuric acid, and the resulting sulphates subjected to electrolysis. In another alternative the nickel may be treated with carbon monoxide to form nickel carbonyl, from which nickel is deposited in the known manner. The nickel powder may be treated with reducing gases, such as hydrogen, at 180°C.–200°C., and is then particularly suitable for the hydrogenation of oils. Reference is directed in pursuance of Section 7, Sub-section 4, of the Patents and Designs Acts, 1907 and 1919, to Specifications Nos. 499/1893, 11,581/1893 and 6,914/1894.

169,264. SULPHURIC ANHYDRIDE, APPARATUS FOR THE MANUFACTURE OF. P. Audianne, 117, Boulevard Haussmann, Paris. Application date, June 21, 1920.

The apparatus is for the manufacture of sulphuric anhydride by the contact process, and the object is to obtain a better



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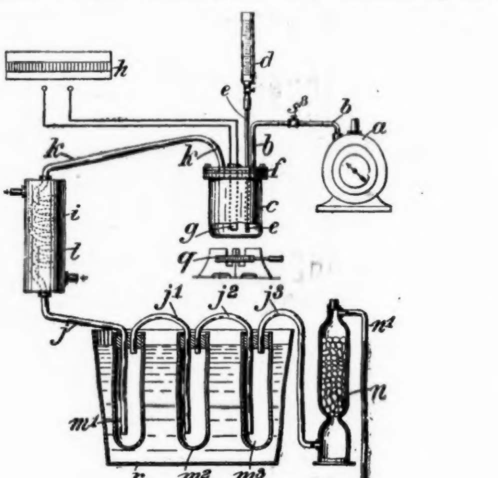
distribution of the gas through the catalytic mass, and uniformity of temperature. The reaction chamber 1 contains a number of vertical tubes 2, which are freely open at the top, but contain small helical plugs 3 at the bottom to mix the gases. The tubes are fixed in a tube plate 4 at the bottom,

and in a plate 5 at the top, which is also pierced with a number of small holes of about 10 mm. diameter. The upper ends of the tubes are surrounded by the catalyst 7, which contains 0·2 to 0·4 per cent. of platinum, and is supported on the plate 8. The lower part of the chamber 1 contains a granulated substance 9 supported on a perforated plate 10. A mixture of sulphur dioxide and air normally passes by the pipe 19 into a heat exchanger 14, through which it passes around the tubes 15 to a pipe 20, valve 21, and pipe 6, and thence through the tubes 2 of the catalyser. To start the apparatus, the valve 21 is closed and the valves 23 and 26 opened, so that the gases are diverted through the heater 24 to obtain an increased temperature. Gas after rising through the tubes 2 passes downwards through the catalytic material 7 and then through the material 9, so that the catalyser acts also as a heat interchanger, and thus maintains a constant temperature. The sulphur trioxide then passes into an annular collector 11, and thence through the pipe 13 to the heat exchanger 14, and then to the outlet 18. The residual heat is thus utilised in heating the incoming gas.

169,288. ORE CONCENTRATION. Minerals Separation, Ltd., 62, London Wall, London, E.C. 2. (From E. W. Wilkinson, 61, Broadway, New York.) Application date, June 23, 1920.

The process is for concentrating ore by froth flotation. An organic substance is subjected to a temperature which partly decomposes it in the presence of air, and the products of this operation are used as the mineral frothing agent. The organic substance may be a petroleum product, such as kerosene or gas oil, a bituminous substance such as bitumen or bituminous coal, wood or the like, oleic acid or cotton-seed oil. When the organic substance is a liquid it is supplied to a copper retort *c* heated by a burner *q*, and air is supplied through a gas meter *a*, regulating valve s^3, and tube *b*, which terminates near the top of the retort. The material to be treated is supplied from a burette *d* through a tube *e* terminating near



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the bottom of the retort and the temperature is indicated by means of a thermo-couple *g*. The products of partial combustion are drawn off through a tube *k* to a condenser *l* consisting of a coiled tube *i* immersed in a water-jacket. The products then pass through a tube *j* to three condensing vessels m^1, m^2, m^3, arranged in series and immersed in a water-bath *r*. The gas is then passed through a scrubber *n* to remove the residual products and then passes on to an air pump *o*. In an example, particulars are given of the treatment of the kerosene known as "comfort oil." The retort *c* is heated to about 550°C., and an oily liquid is collected in the vessels m^2, m^3, and *n*, while the vessel m^1 contains in addition an aqueous liquid at the bottom. The oily condensates were found to be good frothing agents, but larger quantities of the aqueous condensate were found to be necessary. An example of the treatment of zinc ore from Montana is given. The ore was made into a pulp with water in the proportion of 1 to 3·4, and this was acidified with acetic acid in the proportion of 11 lb. per 1,000 lb. of ore. 0·88 lb. of the mixed oily condensate per 1,000 lb. of ore is added, and the mixture subjected to frothing. It is found that the uncondensed gaseous product delivered from the outlet pipe *p* is also a good mineral frothing agent. Other examples are given of the preparation of a frothing agent from paraffin gas-oil and from oleic acid and cotton-seed oil, and the use of these frothing agents in the concentration of zinc ore. It is found that the products from oleic acid may be used in the cold, while oleic acid itself usually requires a heated pulp. A modified apparatus is also described for use in the treatment of bituminous coal or wood to produce a mineral frothing agent, in which case a combustion chamber is used in place of the retort *c*. Another apparatus for the treatment of gas-oil is described in which no condenser is provided, but the products are delivered directly into a frothing machine. A liquid petroleum product such as kerosene may also be treated by saturating a porous material with it, breaking up the material, and then igniting it.

169,301. ALUMINA FROM CLAY, PROCESS FOR PREPARATION OF. F. W. Howorth, London. (From A/S Hoyangsfaldene Norsk Aluminium Co., 5, Lökkeveien, Christiania, Norway.) Application date, June 29, 1920.

The object is to produce alumina for the aluminium industry from ordinary clay as the raw material. The clay is dried in air but not calcined, and then treated with chamber sulphuric acid, the clay being in excess. The heat of the reaction raises the temperature to about 140°C. and the iron compounds in the clay are mainly converted into ferrous sulphate. Any ferric sulphate formed is precipitated as basic ferric sulphate in the presence of excess of clay. The mixture is then heated to about 200°C., which converts the silica in the clay into a form which is readily filtered. The mixture is then lixiviated with hot water to produce a solution of about 1·3 to 1·4 sp. gr. (35°Bé.), which contains about 80-90 grammes of alumina per litre. The solution is filtered, and then cooled to precipitate potash alum, which is filtered off. Powdered potassium sulphate (obtained at a later stage in the process) is then added to the liquid to precipitate a further quantity of potash alum. The mother liquor may be used in the lixiviation process. The alum is freed from iron sulphate by re-crystallisation from a hot solution. The crystallised alum is then introduced into the hottest zone of a revolving tube furnace whereby the water of crystallisation is driven off without agglomeration of the material. The alum is then heated to 700°-800°C. whereby it is converted into alumina and potassium sulphate, while sulphur oxides are driven off. The potassium sulphate is then dissolved out by heating with cold saturated potassium sulpahte solution, and the alumina filtered off in a filter press. The potassium sulphate is used for the precipitation of alum in the second stage of the process.

169,323. FERTILIZERS, PRODUCTION OF. J. C. Kernot, 4, Vineyard Hill Road, Wimbledon, London, S.W. 19, and British Glues & Chemicals, Ltd., Imperial House, Kingsway, London, W.C. 2. Application date, July 12, 1920.

The process is for producing a fertilizer from bones containing soluble and insoluble phosphates, ammonium chloride or nitrate, and other nitrogenous substances. Bones are treated with hydrochloric acid or nitric acid at about 15°C., and the solution is neutralised with ammonia. The mixture, including the precipitate, is then evaporated to dryness with constant stirring to obtain a granulated product. The tri-calcium phosphate in the mixture is dissolved in the soil by free acid liberated by the ammonium chloride or nitrate.

169,347. PHENOL-ALDEHYDE CONDENSATION PRODUCTS, PROCESS FOR THE MANUFACTURE OF. H. V. Potter and W. F. Fleet, 98, Bradford Street, Birmingham, and the Damard Lacquer Co., Ltd., 82, Victoria Street, London, S.W. 1. Application date, July 23, 1920.

The process is for the production of a resinous substance which remains soluble and does not harden when heated. The material is prepared by condensing phenol or its homologues with acetaldehyde or its polymers. Formaldehyde may also be added to make the product less soluble, or insoluble, or to make it harden when heated. Accelerators

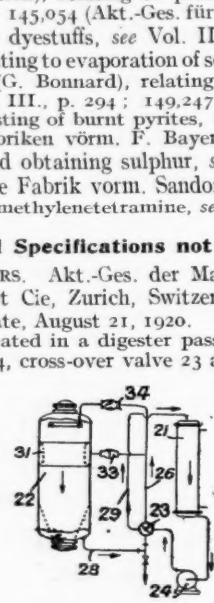
may be used, such as sulphuric acid, caustic alkali, oxalic acid, phenyl hydrazine hydrochloride, etc. In one example the mixture consists of phenol 100 parts, paraldehyde 75 parts, and concentrated sulphuric acid 5 parts. Another example consists of phenol 100 parts, paraldehyde 45 parts, ammonia (0·88 sp. gr.) 5 parts, to which formaldehyde (40 per cent. solution) 45 parts may be added at any stage of the process.

NOTE.—Abstracts of the following specifications, which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention :—140,394 (Nitrogen Corporation), relating to production of nitrogen compounds, *see* Vol. II., p. 563 ; 140,439 (Nitrogen Corporation), relating to production of ammonia, *see* Vol. II. p. 563 ; 145,054 (Akt.-Ges. für Anilin Fabrikation), relating to trisazo dyestuffs, *see* Vol. III., p. 242 ; 145,079 (G. A. Krause), relating to evaporation of solutions, *see* Vol. III., p. 243 ; 145,789 (G. Bonnard), relating to refining tin and antimony, *see* Vol. III., p. 294 ; 149,247 (J. Simon), relating to chloridising roasting of burnt pyrites, *see* Vol. III., p. 519 ; 153,297 (Farbenfabriken vorm. F. Bayer & Co.), relating to purifying gases and obtaining sulphur, *see* Vol. IV., p. 106 ; 165,084 (Chemische Fabrik vorm. Sandoz), relating to a new derivative of hexamethylenetetramine, *see* Vol. V., p. 216.

International Specifications not yet Accepted

168,304. DIGESTERS. Akt.-Ges. der Maschinenfabriken Escher, Wyss, et Cie, Zurich, Switzerland. International Convention date, August 21, 1920.

Liquid to be treated in a digester passes from a heater 21 through a pump 24, cross-over valve 23 and non-return valve



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34 to the top of the digester 22. The liquid passes out through the pipes 28, 29, back to the heater 21. The flow through the digester may be reversed by turning the valve 23 through 90°, so that it passes into the digester by the pipe 28 and then through a strainer 31, non-return valve 33, cross-over valve 23 and pipe 29.

168,324. IODINE. O. von Faber, 73, Regentesselaan, Gravenhage, Holland. International Convention date, August 28, 1920.

To recover iodine from carbonaceous material in which it is absorbed, the material is heated to 500°C., and a stream of air or carbon dioxide is passed through it. The gas may be at a pressure above or below atmospheric and the carbonaceous material may be wholly or partly consumed by the oxidising gas.

LATEST NOTIFICATIONS

170,264. Process of manufacturing hydrocarbons from fatty oils. Kobayashi, K. October 13, 1920.
170,275. Method of treating fuel of vegetable origin with a view to increasing its efficiency. Crespin, L. October 15, 1920.
170,280. Devices for feeding fluid, semi-fluid, and plastic substances. McLaughlin, F. October 1, 1920.
170,287. Method and apparatus for obtaining porous slag in as dry a state as possible. Schol, C. H. March 7, 1918.
170,302. Process for the manufacture of Enzotamine salts. Chemical Works, formerly Sandoz. October 14, 1920.

Specifications Accepted, with Date of Application

141,058. Acrolein, Polymerisation products of, and process of producing the same. C. Moureu and C. Dufraisse. March 31, 1919.
143,873. Calcium carbide, Manufacture of. Union Carbide Co. August 15, 1917.
144,298. Vessel for boiling and evaporating oil, oil-containing liquids, and other organic and pyrogenously decomposable liquids. A. J. G. J. Irinyi. June 26, 1914.
146,411. Fumaric acid, Manufacture of. C. Wehmer. September 28, 1915.
146,427. Tanning preparations, Manufacture and production of. J. Y. Johnson. (*Badische Anilin & Soda Fabrik.*) July 3, 1920.
146,472. Obtaining products from petroleum by decomposition of component hydrocarbons thereof. Standard Oil Co. October 20, 1913.
146,819. Cyanides, Synthetic method of producing. Mitsubishi Kogyo Kabushiki Kaisha. July 7, 1919.
146,870. Arseno compounds of the pyrazolone series. Farbwerke vorm. Meister Lucius & Bruning. December 15, 1917.
146,898. Converting tar oils into neutral oils suitable for lubricating purposes, Process for. M. Melamid. March 11, 1919.
147,030. Manganese dioxide, Process for the production of. E. H. Westling. March 14, 1918.
147,067. Nitrogen, containing addition and condensation products from acetylene and ammonia. Chemische Fabrik Rhenania Akt.-Ges. B. C. Stuer and W. Grob. November 20, 1913.
147,094. Sulphuric acid, Manufacture of. J. Thede. June 24, 1918.
147,134. Superphosphate and similar solidifying pasty masses, Apparatus for opening up, conveying and disintegrating in a continuous manner. G. A. Bruhn. July 28, 1915.
147,173. Phenol-formaldehyde condensation products, Manufacture of. J. Filhol. June 26, 1919.
147,752. White lead, Manufacture of. W. P. Thompson. October 12, 1914.
147,909. Ethylene chloride, Process for the production of. T. Goldschmidt Akt.-Ges., and F. Bergius. February 29, 1916.
163,272. Neutralising oils and fats. Rocca, Tassy and De Roux (Firm of). May 3, 1920.
169,732. Anthraquinone series, Manufacture of compounds of. F. W. Atack and G. W. Clough. March 31, 1920.
169,738. Extraction of oils from vegetable matter, Process and apparatus for. M. Whitehead and E. Scott. April 7, 1920.
169,741. Celluose acetate products, Treatment of. British Cellulose & Chemical Manufacturing Co., Ltd., and J. F. Briggs. April 29, 1920.
169,758. Colloidal metallic elements and compounds thereof, Method of preparing. Chemische Fabriken, Dr. K. Albert and L. Berend. June 3, 1920.
169,763. Hydrocarbon oils, Process of distilling. M. Benson. June 7, 1920.
169,764. Copper, Manufacture of. E. E. Naef. June 19, 1920.
169,807-8. Cements, Manufacture of. H. Wade. (*Bombrini Parodi-Delfino.*) July 5, 1920.
169,829. Shellac-like products, Manufacture of. E. A. Muskett. July 8, 1920.
169,847. Drying and carbonisation of lignite and the like for the production of a tar rich in undecomposed bitumen. F. Seidenschnur. July 15, 1920.
169,863. Azo dyestuffs and intermediate products, Manufacture of. O. Imray. (*Soc. of Chemical Industry in Basle.*) July 23, 1920.
169,870. Filtering liquids, Apparatus for. F. Bloor. July 30, 1920.

Applications for Patents

Barbet et Fils et Cie., E. Removal of tar from vapours from distillation of wood. 28060. October 21. (France, October 21, 1920.)
Burgess, Ledward & Co., Ltd., & Harrison, W. Means for dyeing cellulose acetate. 27616. October 18.
Kelly, T. D. Method of solidifying and preserving alcohol, &c. 27509. October 17.
Nicol, J. S. Straining oils, &c. 28112. October 22.
Otto, E. R., and Villiers London Co. Treatment of castor oil. 27764. October 19.
,, Treatment of mineral, animal, or vegetable oils. 27765. October 19.
Parsons, Sir C. A. Manufacture of glass. 28120. October 22.
Rathsburg, H. Process for manufacture of m-dinitro-o-dinitrosobenzene and its salts. 27903. October 20.

Affairs of the Midland Glue Co.

THE first meeting of the creditors of the Midland Counties Glue Co. was held on October 19 at the offices of Messrs. Phipps & Troup, Wood Hill, Northampton.

The statement of affairs showed unsecured liabilities of £14,729 18s. 11d. ; contingen liabilities amounting to £8,278 5s. ; fully secured creditors as regards capital, £22,000 ; assets £6,293 19s. 5d., less preferential creditors £100, making the net assets £6,193 19s. 5d. The deficiency as against unsecured creditors was £8,535 19s. 6d. It was proposed that Messrs. A. L. Airs and F. Kilby should be appointed liquidators in place of Mr. Foster, who had previously been appointed by the shareholders. An informal committee of inspection was appointed.

Market Report and Current Prices

Our Market Report and Current Prices are exclusive to* THE CHEMICAL AGE, *and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The weekly report contains only commodities whose values are at the time of particular interest or of a fluctuating nature. A more complete report and list are published once a month. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.

Market Report

THURSDAY, October 27.

Whilst the demand for chemicals has been rather slower during the past week, the healthier tendency is maintained, and a fairly brisk business is passing in respect to stocks.

Continental prices in general have been put up to neutralise the fall in exchange, and in many cases often show an advance.

The export demand is fair, but there is room for great improvement.

General Chemicals

ACETONE remains in good demand and is inclined again to be firmer.

ACID ACETIC is much higher in price, and the small stocks command a substantial premium.

ACID CITRIC is unchanged.

ACID FORMIC is rather firmer, and stocks are being steadily depleted.

ACID OXALIC is firmer, but the demand is on the small side.

ACID TARTARIC is distinctly higher in price, but business remains nominal.

AMMONIUM BICHROMATE.—Prices have been reduced by the British makers.

BLEACHING POWDER remains a slow market, and the tendency continues downward.

COPPER SULPHATE is unchanged.

FORMALDEHYDE is firmer on the week and in steady demand.

IRON SULPHATE is unchanged.

LEAD ACETATE remains a nominal market.

LEAD NITRATE.—The demand is very slow, and the prices are unaltered.

LITHOPONE is only in slow demand, but prices seem to have touched bottom.

POTASSIUM BICHROMATE.—British manufacturers have reduced their prices.

POTASSIUM CARBONATE is unchanged.

POTASSIUM CAUSTIC remains a weak market, and stocks are difficult to dispose of.

POTASSIUM CHLORATE is very slow and favours buyers.

SODIUM ACETATE is in good demand, and the price is inclined to harden.

SODIUM BICHROMATE and SODIUM CHROMATE.—The price of both has been reduced by British manufacturers.

SODIUM CAUSTIC is unchanged.

SODIUM NITRITE.—Only a nominal business is reported, but higher prices are asked for forward delivery.

SODIUM PHOSPHATE is unchanged.

SODIUM PRUSSIATE is again firmer and supplies are very short.

Coal Tar Intermediates

Business continues on quiet lines with a small inquiry about and a certain number of orders being placed for immediate delivery.

ALPHA NAPHTHYLAMINE continues to be inquired for and the price is without change.

ANILINE OIL AND SALT.—A few orders have been placed at recent figures and the export market has shown slight signs of activity.

ANTHRAQUINONE is unchanged.

BENZIDINE BASE has been inquired for and a fair business has been passing.

BETA NAPHTHOL.—A few inquiries are about, but little business is actually moving.

DIMETHYLANILINE is in fair request at recent values.

DIPHENYLAMINE continues to be inquired for and the price is without alteration.

"H" ACID is quiet and steady.

PARANITRANILINE continues in small request at recent figures.

RESORCIN is quiet, but a small business has been passing.

SALICYLIC ACID continues firm at last quoted price.

Coal Tar Products

There is little change in the market for coal tar products from last week.

90'S BENZOL is perhaps a little more plentiful, and is quoted at 2s. 7½d. on rails in the Midlands and 2s. 11d. in London.

PURE BENZOL is still very scarce and is worth about 3s. 6d. a gallon on rails.

CREOSOTE OIL is weak at 7¼d. to 7½d. in the North, and 7¾d. to 8d. in the South.

CRESYLIC ACID is inactive and is worth 2s. 2d. on rails for the pale quality and 1s. 9d. to 1s. 11d. for the dark quality.

SOLVENT NAPHTHA is rather weaker and is worth about 2s. 8d. on rails in the Midlands and 2s. 11d. to 3s. in London.

NAPHTHALENE is being quoted at from £5 to £8 per ton for the crude qualities, and £14 to £18 for the refined, and is very quiet.

PITCH.—The position is unchanged.

Sulphate of Ammonia

The market is firm and there is a good inquiry for export.

To-day's price for the Colonies is £16 10s. per ton, f.o.b.; for other destinations £17 to £17 10s. per ton, f.o.b.

Current Prices

Chemicals

	per	£	s.	d.		£	s.	d.
Acetic anhydride	lb.	0	2	1	to	0	2	2
Acetone oil	ton	87	10	0	to	90	0	0
Acetone, pure	ton	90	0	0	to	95	0	0
Acid, Acetic, glacial, 99-100%	ton	60	10	0	to	62	10	0
Acetic, 80% pure	ton	45	0	0	to	43	0	0
Arsenic	ton	95	0	0	to	100	0	0
Boric, cryst	ton	65	0	0	to	68	0	0
Carbolic, cryst. 39-40%	lb.	0	0	6½	to	0	0	7
Citric	lb.	0	2	5	to	0	2	6
Formic, 80%	ton	65	0	0	to	67	10	0
Gallic, pure	lb.	0	3	9	to	0	4	0
Hydrofluoric	lb.	0	0	8½	to	0	0	9
Lactic, 50 vol.	ton	43	0	0	to	45	0	0
Lactic, 60 vol.	ton	46	0	0	to	48	0	0
Nitric, 80 Tw.	ton	38	0	0	to	40	0	0
Oxalic	lb.	0	0	8½	to	0	0	9
Phosphoric, 1.5	ton	45	0	0	to	47	0	0
Pyrogallic, cryst	lb.	0	7	3	tc	0	7	6
Salicylic, Technical	lb.	0	1	2	to	0	1	3
Salicylic, B.P.	lb	0	1	6	to	0	1	7
Sulphuric, 92-93%	ton	8	0	0	to	8	10	0
Tannic, commercial	lb.	0	3	6	to	0	3	9
Tartaric	lb.	0	1	5	to	0	1	6
Alum, lump	ton	18	0	0	to	18	10	0
Alum, chrome	ton	37	10	0	to	40	0	0
Alumino ferric	ton	9	0	0	to	9	10	0
Aluminium, sulphate, 14-15%	ton	12	0	0	to	13	0	0
Aluminium, sulphate, 17-18%	ton	15	0	0	to	16	0	0
Ammonia, anhydrous.	lb.	0	1	10	to	0	2	0
Ammonia, .880	ton	35	0	0	to	37	0	0
Ammonia, .920	ton	22	0	0	to	24	0	0
Ammonia, carbonate	lb.	0	0	4	to		—	
Ammonia, chloride	ton	60	0	0	to	65	0	0
Ammonia, muriate (galvanisers)	ton	45	0	0	to	47	10	0
Ammonia, nitrate	ton	55	0	0	to	60	0	0
Ammonia, phosphate	ton	90	0	0	to	95	0	0
Ammonia, sulphocyanide	lb.	0	3	0	to	0	3	0
Amyl acetate	ton	150	0	0	to	160	0	0
Arsenic, white, powdered	ton	42	0	0	to	44	0	0

	per	£	s.	d.		£	s.	d.
Barium, carbonate, 92-94%	ton	12	10	0	to	13	0	0
Barium, chlorate	lb.	0	0	11	to	0	1	0
Chloride	ton	15	0	0	to	16	0	0
Nitrate	ton	42	10	0	to	45	0	0
Barium Sulphate, blanc fixe, dry	ton	26	0	0	to	28	0	0
Sulphate, blanc fixe, pulp	ton	16	0	0	to	16	10	0
Sulphocyanide, 95%	lb.	0	1	6	to	0	1	0
Bleaching powder, 35-37%	ton	14	0	0	to		—	
Borax crystals	ton	31	0	0	to	32	0	0
Calcium acetate, Brown	ton	8	0	0	to	9	0	0
,, Grey	ton	10	0	0	to	11	0	0
Calcium Carbide	ton	22	0	0	to	23	0	0
Chloride	ton	12	10	0	to	13	0	0
Carbon bisulphide	ton	60	0	0	to	62	0	0
Casein, technical	ton	85	0	0	to	90	0	0
Cerium oxalate	lb.	0	3	6	to	0	3	9
Chromium acetate	lb.	0	1	1	to	0	1	3
Cobalt acetate	lb.	0	11	0	to	0	11	6
Oxide, black	lb.	0	10	6	to	0	11	0
Copper chloride	lb.	0	1	3	to	0	1	6
Sulphate	ton	29	10	0	to	30	10	0
Cream Tartar, 98-100%	ton	130	0	0	to	135	0	0
Epsom salts (*see* Magnesium sulphate)								
Formaldehyde 40% vol.	ton	95	0	0	to	97	0	0
Formusol (Rongalite)	lb.	0	3	9	to	0	4	0
Glauber salts, commercial	ton	5	5	0	to	5	10	0
Glycerine, crude	ton	70	0	0	to	72	10	0
Hydrogen peroxide, 12 vols.	gal.	0	2	8	to	0	2	9
Iron perchloride	ton	35	0	0	to	40	0	0
Iron sulphate (Copperas)	ton	4	0	0	to	4	5	0
Lead acetate, white	ton	48	0	0	to	50	0	0
Carbonate (White Lead)	ton	43	0	0	to	46	0	0
Nitrate	ton	48	10	0	to	50	10	0
Litharge	ton	35	10	0	to	36	0	0
Lithopone, 30%	ton	26	0	0	to	28	0	0
Magnesium chloride	ton	12	0	0	to	13	0	0
Carbonate, light	cwt.	2	10	0	to	2	15	0
Sulphate (Epsom salts commercial)	ton	10	10	0	to	11	10	0
Sulphate (Druggists')	ton	15	10	0	to	17	10	0
Manganese, Borate	ton	70	0	0	to	75	0	0
Sulphate	ton	70	0	0	to	75	0	0
Methyl acetone	ton	85	0	0	to	90	0	0
Alcohol, 1% acetone	ton	105	0	0	to	110	0	0
Nickel sulphate, single salt	ton	65	0	0	to	66	0	0
Nickel ammonium sulphate, double salt	ton	67	0	0	to	68	0	0
Potash, Caustic	ton	33	0	0	to	33	10	0
Potassium bichromate	lb.	0	0	7¾	to		—	
Carbonate, 90%	ton	31	0	0	to	33	0	0
Chloride	ton	36	0	0	to	38	0	0
Chlorate	lb.	0	0	5	to	0	0	5½
Meta bisulphite, 50-52%	ton	120	0	0	to	125	0	0
Nitrate, refined	ton	45	0	0	to	47	0	0
Permanganate	lb.	0	1	2	to	0	1	4
Prussiate, red	lb.	0	2	4	to	0	2	6
Prussiate, yellow	lb.	0	1	2½	to	0	1	3
Sulphate, 90%	ton	31	0	0	to	33	0	0
Salammoniac, firsts	cwt	3	5	0	to		—	
Seconds	cwt	3	0	0	to		—	
Sodium acetate	ton	28	0	0	to	30	0	0
Arsenate, 45%	ton	45	0	0	to	48	0	0
Bicarbonate	ton	10	10	0	to	11	0	0
Bichromate	lb.	0	0	6½	to	0	0	7
Bisulphite, 60-62%	ton	25	0	0	to	27	10	0
Chlorate	lb.	0	0	4¾	to	0	0	5
Caustic, 70%	ton	24	0	0	to	24	10	0
Caustic, 76%	ton	25	10	0	to	26	0	0
Hydrosulphite, powder, 85%	lb.	0	2	3	to	0	2	6
Hyposulphite, commercial	ton	15	0	0	to	16	0	0
Nitrite, 96-98%	ton	40	0	0	to	42	0	0
Phosphate, crystal	ton	23	10	0	to	25	10	0
Perborate	lb.	0	1	6	to	0	1	7
Prussiate	lb.	0	0	8½	to	0	0	9
Sulphide, crystals	ton	17	0	0	to	18	0	0
Sulphide, solid, 60-62%	ton	24	10	0	to	25	10	0
Sulphite, cryst.	ton	15	0	0	to	16	0	0
Strontium carbonate	ton	80	0	0	to	85	0	0
Strontium Nitrate	ton	70	0	0	to	72	10	0
Strontium Sulphate, white	ton	7	10	0	to	3	10	0
Sulphur chloride	ton	41	0	0	to	42	0	0
Sulphur, Flowers	ton	13	0	0	to	14	0	0
Roll	ton	13	0	0	to	14	0	0
Tartar emetic	lb.	0	1	6	to	0	1	7
Tin perchloride, 33%	lb.	0	1	2	to	0	1	4
Tin Perchloride, solid	lb.	0	1	5	to	0	1	7
Protochloride (tin crystals)	lb.	0	1	5	to	0	1	6
Zinc chloride, 102 Tw.	ton	21	0	0	to	22	10	0
Chloride, solid, 96-98%	ton	50	0	0	to	55	0	0
Oxide, 99%	ton	40	0	0	to	42	0	0
Dust, 90%	ton	47	10	0	to	50	0	0
Sulphate	ton	21	10	0	to	22	10	0

Coal Tar Intermediates, &c.

	per	£	s.	d.		£	s.	d.
Alphanaphthol, crude	lb.	0	3	3	to	0	3	6
Alphanaphthol, refined	lb.	0	3	9	to	0	4	0
Alphanaphthylamine	lb.	0	2	6	to	0	2	8
Aniline oil, drums extra	lb.	0	1	5	to	0	1	6
Aniline salts	lb.	0	1	6	to	0	1	7
Anthracene, 40-50%	unit	0	0	8½	to	0	0	9
Benzaldehyde (free of chlorine)	lb.	0	4	3	to	0	4	6
Benzidine, base	lb.	0	6	0	to	0	6	6
Benzidine, sulphate	lb.	0	6	6	to	0	7	0
Benzoic acid	lb.	0	2	3	to	0	2	6
Benzoate of soda	lb.	0	2	3	to	0	2	6
Benzyl chloride, technical	lb.	0	2	0	to	0	2	3
Betanaphthol benzoate	lb.	0	5	9	to	0	6	0
Betanaphthol	lb.	0	2	3	to	0	2	6
Betanaphthylamine, technical	lb.	0	9	0	to	0	9	6
Croceine Acid, 100% basis	lb	0	4	6	to	0	5	0
Dichlorbenzol	lb.	0	0	9	to	0	0	10
Diethylaniline	lb.	0	6	9	to	0	7	6
Dinitrobenzol	lb.	0	1	5	to	0	1	6
Dinitrochlorbenzol	lb.	0	1	5	to	0	1	6
Dinitronaphthaline	lb.	0	1	6	to	0	1	8
Dinitrotoluol	lb.	0	1	8	to	0	1	9
Dinitrophenol	lb.	0	2	9	to	0	3	0
Dimethylaniline	lb.	0	3	9	to	0	4	0
Diphenylamine	lb.	0	4	6	to	0	4	9
H-Acid	lb.	0	8	0	to	0	8	6
Metaphenylenediamine	lb.	0	5	6	to	0	5	9
Monochlorbenzol	lb.	0	0	10	to	0	1	0
Metanilic Acid	lb.	0	6	6	to	0	7	0
Monosulphonic Acid (2:7)	lb.	0	7	0	to	0	7	6
Naphthionic acid, crude	lb.	0	4	0	to	0	4	3
Naphthionate of Soda	lb.	0	4	3	to	0	4	6
Naphthylamin-di-sulphonic-acid	lb.	0	4	9	to	0	5	0
Nitronaphthalene	lb.	0	1	4	to	0	1	5
Nitrotoluol	lb.	0	1	3	to	0	1	4
Drthoamidophenol, base	lb.	0	18	0	to	1	0	0
Orthodichlorbenzol	lb.	0	1	1	to	0	1	2
Orthotoluidine	lb.	0	2	3	to	0	2	6
Orthonitrotoluol	lb.	0	0	10	to	0	1	0
Para-amidophenol, base	lb.	0	12	0	to	0	12	6
Para-amidophenol, hydrochlor	lb	0	12	6	to	0	13	0
Paradichlorbenzol	lb.	0	0	7	to	0	0	8
Paranitraniline	lb.	0	4	6	to	0	4	9
Paranitrophenol	lb.	0	2	9	to	0	3	0
Paranitrotoluol	lb.	0	5	9	to	0	6	0
Paraphenylenediamine, distilled	lb.	0	12	0	to	0	13	0
Paratoluidine	lb.	0	7	0	to	0	7	6
Phthalic anhydride	lb.	0	3	9	to	0	4	0
Resorcin, technical	lb.	0	5	0	to	0	5	6
Resorcin, pure	lb.	0	8	0	to	0	8	6
Salol	lb.	0	2	6	to	0	2	9
Sulphanilic acid, crude	lb.	0	1	4	to	0	1	6
Tolidine, base	lb.	0	6	6	to	0	7	0
Tolidine, mixture	lb.	0	2	6	to	0	2	9

French Potash

THE trade in potash fertilisers has become less speculative since the wide range of prices which tended to disorganise the market during the early part of the fertiliser season has now become narrowed down to more stable limits. All the grades are being sold at prices which are less than half of those ruling at this season last year, consequently buyers who have restricted their purchases during the past few years are now coming forward with larger orders. This applies particularly to the Eastern and Southern Counties, and other light-land districts. Potash fertilisers such as French Kainit are also more in demand this season owing to the shortage of h gh-grade basic slag for the top dressing of grass land. To make up the deficiency it has been found advantageous to use a larger dressing of potash along with basic slag, the action of these two constituents together being much more effective than where one of them is applied alone.

The production of potash salts from the Alsatian Mines is being well maintained. During the first half of 1921 the total output was 604,142 tons.

Company News

AMALGAMATED ZINC (DE BAVAY'S).—The directors in their half-yearly report recommend the payment of a dividend at the rate of 1s. per share.

ANGLO-CHILIAN NITRATE & RAILWAY CO., LTD.—The board have decided to pay an interim dividend of 1s. per preference share, and 1s. per ordinary share, both free of tax, payable on November 15 to holders on the register at October 28. Last year 10 per cent. was paid on both classes of shares.

ANGELA NITRATE CO., LTD.—The directors have declared an interim dividend of 5 per cent., a 1s. per share, less tax, payable on November 14. The transfer books will be closed from November 1 to 12 inclusive. A year ago the interim payment was 10 per cent.

BROKEN HILL PROPRIETARY CO.—The company has received a cable from the head office in Melbourne stating that the directors have reluctantly decided to pass the declaration of a dividend for the November quarter until they can more clearly ascertain the position as to the prospects in the immediate future.

An Automatic Boiler-Feed Regulator

JAMES BALDWIN & CO., of Devonshire Brass Works, Keighley, Yorks, have recently placed on the market an automatic boiler feed water regulator in which a valve in the end of the feed pipe is directly controlled by a float within the boiler. This obviates the necessity for bringing any moving part through the shell of the boiler, a feature which militates against the continued satisfactory working of some classes of regulator.

A branch is taken out of the main feed pipe just below the usual check valve and is fitted with a screw-down feed valve. A pipe leads from this valve to a second check valve and thence down through the crown of the boiler to just below the water level, where it ends in the feed regulating valve. This valve is of the simple four-feathered type and has an interchangeable renewable seating. It is operated by a balanced lever, at the outer end of which there is attached a tube float of the type which the makers have used for many years past in connexion with high ana low-water alarms. The float can, it is claimed, be adjusted on its spindle to suit any water level and is steadied by a radius rod reaching back to the inlet pipe. The valve opens downwards, so that as the water level in the boiler falls the valve is opened to admit more water. If it is desired to feed the boiler freely when the water is already high and the regulator is consequently closed, the ordinary check valve is opened. Otherwise this valve is kept shut during working hours. This arrangement is said to work quite satisfactorily in installations where several boilers are fed from one pump, and it is not necessary to control the steam supply to the feed pump in accordance with the amount of water it has to deliver. When, however, only one boiler is at work at a time it is generally advisable to control the feed pump. In such cases the control valve for the feed pump is actuated from the feed valve control lever.

It is now definitely announced that the Prince Rupert Pulp and Paper Company will go ahead at once with construction of the first unit of its 200 tons per day SULPHITE MILL, having an initial output of 40 tons per day. This company recently purchased the British Columbia holdings of the North Empire Timber Company, approximately 1,000,000,000 ft., of which fully 90 per cent. is spruce and hemlock. The movement of paper from British Columbia paper mills to New Zealand and Australia has shown considerable improvement, and transportation companies are anticipating yet more increased activity All ships now sailing from Vancouver carry fromeao to 1,5000 tons of paper each.

Experiments in making paper from Australian hardwood conducted in the State Products Laboratory of Western Australia are reported to have given satisfactory results. It has been ascertained that the local mountain ash and karri, aged eight years, are the best pulp producers yet discovered. The nipa palm, which grows extensively in Papua, is said to produce a pulp capable of making the finest paper, and fruit from which a valuable motor-spirit can be distilled in payable quantities.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REF. No.
Toronto ...	Crude drugs, fine and industrial chemicals	—
Zurich ...	Drugs	—
San Francisco	China clay; heavy chemicals; oxide of iron: fertilisers; pig iron	—
Argentina ...	Heavy and fine chemicals; india-rubber goods	—
Zurich ...	Glassware	353
Zurich ...	Cod liver oil and allied products ...	352
Tunisian ...	Chemicals; pharmaceutical products	354
Los Angeles, California	Chemicals	358

Tariff Changes

SWITZERLAND.—As from August 1, the prepared colours, varnishes, lacquer varnishes, and siccatives, falling under Nos. 1107-1111 and 1113 of the Swiss Customs Tariff, manufactured with alcohol, which had formerly been exempted from the alcohol monopoly tax, are subject to such tax at the rate of 10 francs per 100 kilogs., gross weight.

GERMANY (OCCUPIED TERRITORY). — H.M. Commercial Secretary at Cologne has forwarded particulars of modifications which have been made to the list of goods which may be imported without licence across the eastern and western frontiers of the Occupied Territory, as well as a list of goods which are not subject to export licence when exported across the western frontier. Further information regarding these lists may be obtained on application to the Tariff Section of the Department of Overseas Trade, 18, Queen Anne's Gate, S.W.1.

Position of Japanese Soda Industry

THE chemical trade in Japan, which flourished exceedingly during the war, has been compelled to undergo extensive re-adjustment since the armistice, and all companies have suffered a sharp decline in prosperity, according to the *Japan Chronicle*. As one of the most prominent illustrations of this, the soda industry, which increased more than fourfold during the war, may be mentioned. Before the war as much as 80 per cent. of the domestic consumption was supplied with overseas goods, and the demand for soda ash is still almost wholly met by imports, but the local production of caustic soda has been increasing yearly since the Russo-Japanese War. The output of 5,000,000 lb. in 1906 increased to 9,500,000 lb. in 1913; on the other hand, imports increased from 19,400,000 lb. to 23,000,000 lb. in the same period. The position of the industry now is that there is an excess of supplies, cost of production is high, while foreign goods come in at prices that prevent either the profitable sale of stocks or continuance of manufacture.

The situation is such that as European and American industrial circles approach their pre-war conditions quotations on caustic soda show signs of returning to pre-war figures, so that the Japanese trade must come to an end. To avert this calamity the customs duty has been greatly increased, but it is doubtful whether, even with the help of this protective duty, the domestic trade will be able to keep out imports. It is estimated that the cost of producing 100 lb. of caustic soda and 220 lb. of bleaching powder is 28·50 yen, after calculating the cost of salt, coal, lime, electric power, and other expenses. If these are sold at market prices the gross proceeds come to 29·24 yen, with a profit of some 70 sen.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette

Bankruptcy Information

CHEETHAM, Reginald Spencer, 48, Bridge Street, Peterborough, druggist. Date of receiving order, October 20. Debtor's petition.

KEENE COMPANY, THE, 52, Gray's Inn Road, London, manufacturing chemists. Receiving order, October 19, creditor's petition. First meeting, November 1, 11 a.m., and public examination, January 27, 1922, 11 a.m., Bankruptcy Buildings, Carey Street, London, W.C. 2.

CHAMBERS, ALFRED (trading as John James Chambers & Son), of 194, High Street, Stoke Newington, and 13, St. Andrew's Pavement, Dunsmure Road, Stamford Hill, oil and colourman. A bankruptcy petition has been presented by Coombs Bros. & Sons, Ltd., 37, Rathbone Street, Canning Town, and will be heard in the High Court of Justice on November 1, at 11 a.m. Carter & Bell, 10A, Idol Lane, Eastcheap, E.C., 3, solicitors for the petitioning creditors.

Liquidators' Notices

ALLEN'S DRUG STORES, LTD. (In voluntary liquidation.) Particulars of claims by November 13 to the liquidator, G. B. Manley, 80A, Coleman Street, E.C.

INECTO, LTD.—A meeting of creditors at the offices of Moore, Stephens & Co., chartered accountants, 2, Gresham Buildings, Guildhall, on Monday, October 31, at 11 a.m. H. J. De C. Moore, liquidator.

Company Winding-up

TAR BURNERS, LTD. Winding-up order, October 18.

SOLAC, Ltd., 221, Tottenham Court Road, W. Meetings: Creditors, November 4, 11.30 a.m.; and contributories, November 4, 12 noon; Bankruptcy Buildings, Carey Street, Lincoln's Inn, London, W.C.2.

County Court Judgments

[*NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.*]

DAVIES, A. T. & CO., 112, First Avenue, Bushill Park, Enfield, oil merchants. £20 8s. 2d. September 15.

HOBLYN, E. R., 3, King Street, Plymouth, chemist. £14 17s. 1d. September 15.

HOWSON, R. F., 114, Leonard Road, Hanley, chemist. £43 4s. 9d. September 19.

JAMES, H. PALMER, Tudor House, Tudor Square, Tenby, chemist. £22 3s. 7d. September 15.

KEMP & CO., LTD., 220, Holloway Road, N., chemists. £11 5s. 5d. September 15.

PETERKIN'S DRUG STORES, 279, Garratt Lane, S.W., chemists. £16 9s. 7d. September 16.

WENYON, CONRAD GALLIMORE, and WENYON, HELEN (his wife), 58, Bankfield Road, Huddersfield, analytical chemists. £50 12s. 8d. September 14.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, created after July 1, 1908, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges which would, if created after July 1, 1908, require registration. The following Mortgages and Charges have been so registered. In each case the total debt, as specified, in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.*]

PIRIE'S PHOTOGRAPHIC PAPER CO., LTD., London, E.C. Registered October 14, mortgage or charge by way of disposition and further security (supplemental to trust deed registered September 27, 1921, securing £150,000 debentures); charged on land and buildings at Newhills, Aberdeen, with fixed plant and machinery. *Nil. June 20, 1921.

Satisfaction

KIRKALDY (J.) & SON, LTD., London, E., paint, varnish manufacturers, &c. Satisfaction registered October 17, £6,000, part of amount registered July 31, 1906.

New Companies Registered

The following list has been prepared for us by Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery Lane, London, W.C.2:—

BOOTH & OPENSHAW (BLACKBURN), LTD., 17-19, St. Peters Street, Blackburn, chemists, druggists, &c. Nominal capital, £2,000 in 2,000 shares of £1 each. Directors: W. W. Openshaw and I. Turner. Qualification of Directors: one share.

BUZZARD GLASS WORKS, LTD., 124, Tottenham Court Road, W.C. Glass-blowers and manufacturers of glassware. Nominal capital, £2,000 in 2,000 shares of £1 each. Directors: A. J. J. Arnold, E. F Arnold and E. H. Langwell.

CHEMICAL AND PULP CO., LTD., 595-596, Salisbury House, London Wall, E.C.2. Dealers in chemicals, manures and dyes, &c. Nominal capital, £5,000 in 5,000 shares of £1 each. Directors: W. S. Hopkins and F. H. Johnson. Qualification of directors, £100.

JOHNSTONE & CUMBERS, LTD., 38, Farringdon Street, E.C. Manufacturers of oil, spirit, gum and other varnishes, &c. Nominal capital, £10,000 in 3,000 7 per cent. cumulative and preference shares, 6,000 ordinary shares of £1 each and 4,000 "B" shares of 5s. each. Directors: F. Cumbers, E. Cumbers, S. Cumbers (chairman and managing director), J. J. Sampson and H. Fuller. Qualification of directors, £100. Remuneration of directors, £50 each; chairman and managing director, £100.

KENDALL PRODUCTS CO., LTD., 6, Surrey Street, Strand, W. C. 2. Soap manufacturers. Nominal capital, £5,000 in 5,000 shares of £1 each. Directors: R. H. Isham, O. P. L. Hoskyns and Sir B. H. Thomson. Qualification of directors, one share.

Judgment in Breach of Contract Action

IN the King's Bench Division on Wednesday, Mr. Justice Rowlatt gave judgment for May & Baker, Ltd., Garden Wharf, London, S.W., for £2,566, with costs, against the Naigai Chemical Trading Co., Ltd., a Japanese firm. The action was brought by May & Baker, Ltd., who claimed damages for breach of contract. Counsel for the plaintiffs said that in response to a cable received from defendants, plaintiffs offered to supply 25 tons of carbolic acid at 2s. 1d. per lb., delivered in London. This offer was accepted and plaintiffs purchased the carbolic acid. In November defendants asked for a cancellation which was refused, but in December plaintiffs accepted the repudiation, intimating that they would claim damages. In the course of evidence with regard to the prices of carbolic acid a witness was cross-examined with reference to a statement in the *Chemical Trade Journal*, in which Messrs. Higginbotham put the price at 1s. 11d. per lb. in December, 1918. Witness said that in the trade they took no notice of that. They were only nominal prices and not the real market price at the time. Giving judgment, his Lordship said there clearly was a concluded contract on the terms alleged by the plaintiffs, and on the question of damages he thought the evidence called for plaintiffs completely justified their claim.

Fraudulent Preferences

MR. JUSTICE LAWRENCE, sitting in bankruptcy on Monday, had before him an application by the trustee for a declaration that three payments made by Joseph Vine, trading as the Toilet Supply Co., 222-24, Harrow Road, London, to his brother, Samuel Vine, were void against the trustee, on the ground that they were fraudulent preferences. His Lordship found that the three payments were fraudulent preferences, and made an order for their repayment to the trustee, with the costs of the motion.

Research Work by U.S.A. Bureau of Mines

THE United States Bureau of Mines is conducting an investigation in the Nevada gold mining fields on the use of gunite in metal mines. The possibility of the cement gun being used in the preventing or minimising of rock bursts in deep metal mines is being given attention.

Employing co-operative funds furnished by the State of Missouri, an investigation relating to the electrothermic metallurgy of zinc is under way at the Mississippi Valley Experiment Station of the Bureau at Rolla, Mo. The physics and chemistry of the condensation of zinc vapour will be especially studied.

An inspection of the mills in the Missouri-Kansas-Oklahoma lead and zinc district is being made by engineers of the Bureau of Mines with a view to determining their general procedure and gathering data as to different phases of the milling practice that may be most amenable to improvement.

At the North Central Experiment Station in Minneapolis investigations regarding drill steel and carbon steel and the reduction of iron oxide are under way. At this Station, the problem of the flow of heat from the walls into the charge of a by-product coke oven has been solved analytically, and the rather tedious numerical solution of the values of the Fourier's series involved is nearly complete.

Results of work done at the North-West Experiment Station in Seattle, Wash., indicate that fine grinding of sponge iron and wet magnetic concentration give a higher recovery of metallic iron than dry magnetic concentration on either coarse or fine material, and that dry magnetic concentration is not improved by fine grinding. In melting sponge iron in a direct arc furnace using amorphous carbon as a carburizer, $2\frac{1}{2}$ per cent. carbon is readily reached with a practical limit of 3 per cent. Using graphitized carbon as a carburizer, 3 per cent. carbon is readily attained, and $4\frac{1}{2}$ per cent. is easily possible.

At the Central District Experiment Station at Urbana, Ill., an examination of samples collected in the Pratt coal seam in Alabama shows that the variation of sulphur content is due almost entirely to variations in the amounts of pyritic sulphur; the organic sulphur content remaining constant. The determination of sulphur in raw coal and washed coal collected at the washery of the Woodward Iron Co., Woodward, Ala., confirms previous conclusions that organic sulphur cannot be removed by washing, and is often higher in the washed coal.

Sugar-cane Wax

LITTLE commercial significance attaches as yet to sugar-cane wax. Efforts are being made, however, to evolve a satisfactory and economical extraction process. The wax exists to the extent of about a quarter per cent. in the sugar cane, and is usually found concentrated in the press cake drawn from the filter presses, after the filtration of the extracted sugar solution The residue may often contain as much as 10 per cent. of the wax from the cane. The chief difficulty up to the present has been in the economical extraction of the wax by means of a volatile solvent, for instance, petroleum spirit, and this difficulty is enhanced when a dry mass is not obtained from the filter presses. It is clear that the extraction of a sludgy mass is accompanied with more difficulties than that of a firm, porous mass of low water content. The mass from which the wax has been successfully removed, when freed from solvent, affords a valuable fertilising agent. The wax, recovered from the solution in petroleum spirit, may be used as a substitute for beeswax in many ap lications.

It has been suggested that the reason for the non-production of sugar-cane wax is the lack of attention to the problem by the sugar-factory chemist, due to pressure of work during the season. That this will not obtain for long in up-to-date sugar factories is evidenced by the developments which are being sought and applied in many other directions, of which may be mentioned the use of waste products (for instance, molasses), as fuel or as a source of alcohol, produced by fermentation. Great improvements in the methods and technique of refining and clarification of the sugar juices are in operation to-day, and the scientific and commercial aspects of all problems in the sugar industry are being more carefully watched than ever before. It is therefore not improbable that sugar-cane wax may appear upon the market in the near future.

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TRADE GUIDE

CHEMICAL AGE

THE Trade Guide is a compact and handy form of reference to a representative list of firms engaged in various branches of the Industry. In most cases fuller particulars may be found by referring to the displayed advertisement elsewhere.